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INFLUENCE OF GRENZ RAYS ON CELL DIVISION AND WOUND HEALING IN THE CORNEAL EPITHELIUM

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AND
RAYMOND L. PFEIFFER, M.D.
NEW YORK

THE EYE is subjected to many forms of radiation for the purpose of treatment or diagnosis. Among these are the grenz rays, which have been used extensively for the past fifteen years. They are soft rays of 1 to 4 angstrom units, intermediate between the ultraviolet and the usual roentgen rays,[1] and have some biologic properties in common with both of these, more familiar, forms of radiant energy, but do not penetrate very deeply into the tissues of the eye.[2]

Grenz rays have been found of value in the treatment of superficial ophthalmic conditions, such as corneal ulcer or episcleritis, and are considered to be safer than ordinary roentgen rays. The clinical application of this form of radiation has been extensively reviewed.[3] Krasso [4] reported histologic changes in the cornea caused by heavy single irradiations of the rabbit eye. Gallardo, Pfeiffer and Thompson [5] found that

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The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Columbia University.

1. Bucky, G.: Grenz Ray Therapy, translated by W. J. Highman, New York, The Macmillan Company, 1929.

2. Sagher, F., and Sagher, E.: Absorption of Infra-Roentgen (Bucky) Rays of Various Qualities by the Anterior Portions of the Eyeball, Arch. Ophth. **30**: 43-53 (July) 1943.

3. (*a*) Pfeiffer, R. L.: Treatment of Diseases of the Eye with Grenz Rays, Arch. Ophth. **21**:976-985 (June) 1939. (*b*) Ellinger, F.: The Biologic Fundamentals of Radiation Therapy: A Textbook, English translation by M. Lenz, New York, Elsevier Pub. Co., 1941.

4. Krasso, I.: Experimentelles und Histologisches über den Einfluss einer einmaligen Bestrahlung mit Bucky's Grenzstrahlen auf das gesunde Kaninchenauge, Ztschr. f. Augenh. **70**:237-256, 1930.

5. Gallardo, E.; Pfeiffer, R., and Thompson, R.: Grenz-Ray Treatment of Experimental Infection of the Cornea, Am. J. Ophth. **23**:41-47, 1940.

infections produced by intracorneal injections of staphylococci healed more rapidly if treated with grenz radiation. These authors had previously reported that the local formation of anitbodies was increased by grenz irradiation.[6]

The effect of ordinary roentgen radiation on cellular proliferation is well known, but that of the grenz rays apparently has not been reported, except for a note by Politzer and Zakovsky[7] on their effect on cell division in urodele larvae. In view of the use of grenz rays on the eye, an investigation of their effect on cell division in the intact, and on regeneration of the injured, corneal epithelium seemed advisable.

METHOD

Male rats, of the Sherman strain, 4 to 6 weeks of age and weighing about 100 Gm., were used in these experiments. In the first series 57 animals were used. With the rat under pentobarbital anesthesia, one eye was given a single treatment of 410 r,[7a] a dose which may be used clinically at three to four day intervals.[8] The rats were killed by decapitation at stages of from six hours to twelve days after irradiation. Litter mates were used throughout this study and were distributed so that animals in one litter were autopsied at various periods after receiving the grenz ray treatment. Four animals were used in each group.

The eyes were fixed in a mixture of solution of formaldehyde U.S.P. and alcohol and the corneas prepared as flat whole mounts according to the method of Buschke, Friedenwald and Fleischmann,[8] with minor modifications. The number of mitoses seen in two to three strips extending across the greatest width of the cornea was counted. The size of the strip was regulated by an Ehrlich stop; a 4 mm. square was placed in a × 10 ocular and used with a × 43 objective. The number of mitotic figures observed in the irradiated (right) eye was compared with the number found in the corresponding epithelial area of the untreated, control (left) eye of the same animal. The difference was expressed as the percentage of the control value. Seventy-five to 150 mitotic figures were counted in the area studied in the normal eyes.

The effect of grenz irradiation on regenerating epithelium was investigated in 29 animals. The injury produced was a standard thermal burn inflicted on the cornea of both eyes with a Shahan thermophore heated to 71 C. The tip of the thermophore was shaped to fit the rat's cornea and made a burn 1.5 mm. wide, which extended horizontally across the cornea. The area of the burn was one-fourth to one-third that of the cornea. The epithelium was completely destroyed, but the superficial portion of the stroma was left intact. The burned cells sloughed

6. Thompson, R.; Pfeiffer, R., and Gallardo, E., Jr.: Stimulation of Local Antibody Formation in Cornea by Grenz Rays, Proc. Soc. Exper. Biol. & Med. **36**:179-181, 1937.

7. Politzer, G., and Zakovsky, J.: Vergleichende Untersuchungen über die Wirkung der Bucky- und der Röntgenstrahlen auf die Zellteilung, Strahlentherapie **42**:165-170, 1931.

7a. The factors were: 10 kilovolts; 4 milliamperes; no added filtration (half value layer, 0.04 mm. aluminum); target skin distance, 8 cm.; circular portal, 8 mm. in diameter.

8. Buschke, W.; Friedenwald, J. S., and Fleischmann, W.: Studies on the Mitotic Activity of the Corneal Epithelium: Methods; Effects of Colchicine, Ether, Cocaine and Ephedrin, Bull. Johns Hopkins Hosp. **73**:143-167, 1943.

within two hours, and after a latent period of about six hours the epithelial cells began to move over the denuded area. The area of the burn was completely covered with a thin layer of cells in fourteen to fifteen hours, but the normal thickness was not restored for several days.

In the experiments on the effect of grenz irradiation on this process, one eye was irradiated, as in the other experiments, and the two eyes were burned equally. Pentobarbital anesthesia was used during irradiation and ether anesthesia when the burns were inflicted. The time between irradiation and injury varied from one hour to ten days. Twelve to fifteen hours after the corneas were burned the rats were killed and the eyes fixed for histologic study. When the eyes were in 80 per cent alcohol, the unhealed portion of the burn could be seen precisely with the aid of a dissecting microscope. Drawings of the unhealed area of the burn were made with the camera lucida. Untreated burns were nearly healed at the twelve hour stage, and completely so at the fifteen hour stage. The areas of the drawings of the irradiated and the control burns were measured with a planimeter and the values compared. The corneas were then stained and the mitotic figures in the regenerating epithelium counted, as in the experiments with the intact corneas.

RESULTS

Irradiation of the rat cornea with grenz rays caused a precipitous drop in the frequency of mitotic figures in the corneal epithelium. The data obtained are presented graphically in figure 1. Six hours after irradiation no mitotic figures were observed in the corneal epithelium of the irradiated eyes. Fifteen hours after irradiation a few cells were to be seen undergoing division, but the number still averaged 78 per cent less than that in the control eyes of the same animals. Mitosis remained greatly depressed for five days after a single irradiation, but on the sixth day the number of figures seen in the irradiated cornea had returned to normal. No difference between the control and the irradiated eyes was noted in any case of the six day group. Some indication of an increase in mitosis in the irradiated eye was noted on the eighth day, but the number of dividing cells was normal in both the irradiated and the control eyes on the tenth and twelfth days after irradiation, when the experiment was terminated. The frequency of mitotic figures in the nonirradiated, control eyes remained at normal levels in all the experiments.

In one experiment the rats were given two irradiations each with the same dose as that used in the other experiments. The second irradiation was made three days after the first, and the animals were autopsied on the third day after the second irradiation. Mitosis was conspicuously inhibited in the irradiated corneal epithelium. Since the inhibiting effect of a single irradiation had disappeared by the sixth day in the first experiment, it appears that the inhibition could be maintained by the second irradiation.

Although these data show that the grenz rays inhibit mitosis, they given no indication at which point the block in that process occurs. For

this reason, the number of figures in various stages of mitosis were determined in control and in irradiated eyes. All figures were classified as prophase, metaphase or telophase. The proportion of each stage observed in the irradiated and in the control epithelium are shown in figure 2. The proportions of figures found in these three stages were similar to those reported by Kaufmann and associates.[9] The distribution of phases noted in normal eyes was almost identical with that observed in the irradiated eyes. This indicates that the radiation acts at some stage prior to the entrance of the cell into the actual division process. The cells are prevented from entering the prophase, but once started the process of division goes on normally.

A greatly reduced dose of grenz rays was applied to two groups of rat eyes by shortening the exposure from sixty to ten and five seconds, respectively. Twenty-four hours after irradiation the average number of mitotic figures was reduced slightly in the ten second exposure group

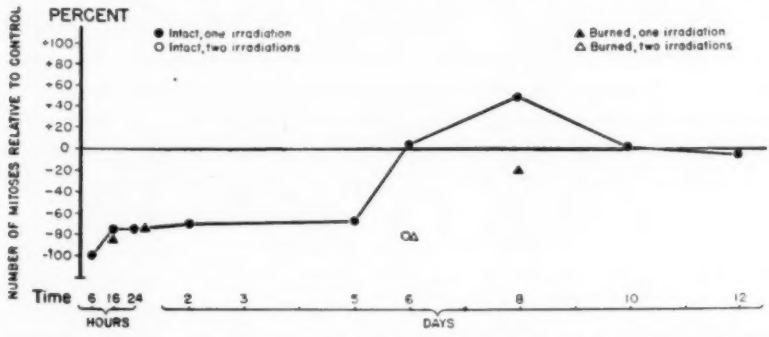

Fig. 1.—Decrease in frequency of mitotic figures in the rat cornea after irradiation with grenz rays.

(— 19 per cent). Only 1 animal of the 5 treated for five seconds showed evidence of inhibition of mitosis. The number of mitotic figures in the corneal epithelium of the irradiated eyes of the other 4 rats did not differ significantly from normal.

In the studies of the effect of grenz rays on regeneration, standard thermal burns were inflicted on both eyes twelve to fifteen hours before autopsy. Since the burns of this severity and size were known to become covered with epithelium in approximately fourteen hours, any delay in this process caused by the irradiation would yield partially covered burns by the fifteen hour stage. On the other hand, if the healing process were stimulated, the healing of the irradiated corneas would be advanced at the twelve hour stage. All the comparisons necessary would be

9. Kaufmann, B.; Gay, H., and Hollaender, A.: Distribution of Mitoses in the Corneal Epithelium of the Rabbit and the Rat, Anat. Rec. **90**:161-178, 1944.

made between the equally burned irradiated and control eyes of the same animal. The right eyes of 11 rats were irradiated one hour before the corneal burns were made and autopsied fifteen hours later. It was found that the epithelium had completely covered the denuded corneal stroma in both the irradiated and the control eye in all but 2 animals. Epithelization was not quite complete in 1 control and 1 irradiated eye in this group. Since irradiation and burning were done almost simultaneously, it appeared that the initial reaction of the tissues to the irradiation might obscure the more fundamental effects. Accordingly, another group, of 4 animals, was given two irradiations three days apart, and the corneal burns were made three days after the last irradiation. The animals were autopsied fifteen hours after the burn had been made. In this series any tissue reactions which immediately follow irradiation would have subsided. Epithelization was complete in all eyes, the control as well as the irradiated. Standard burns were made on a

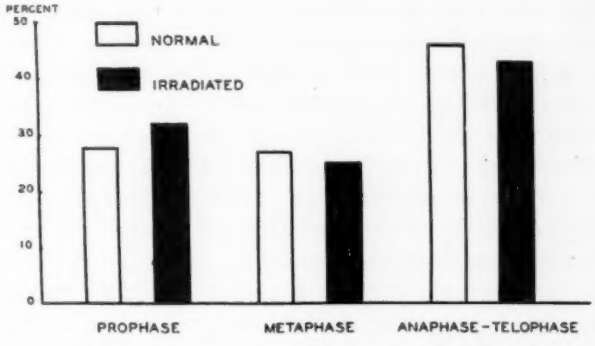

Fig. 2.—Proportions of phases of mitosis in the irradiated and in the control rat cornea.

third group, of 5 animals, seventeen hours after a single irradiation, and autopsies were performed twelve hours after the burns had been made. At this stage epithelization is not quite complete in the normal eyes. In this series, also, grenz rays did not affect cell migration. In 2 rats the migrations of the epithelial cells were equal in the control and the irradiated cornea, and in 2 others the migration was less advanced in the irradiated eye. In the fifth animal epithelization of the control burn was slightly delayed as compared with that of the irradiated burn.

It will be noted that all the experiments on the effect of irradiation on regeneration were carried out during the postirradiation period, in which mitosis would still be inhibited. Counts of mitotic figures showed (fig. 1) that the irradiation markedly inhibited cell division in the regenerating epithelium, although it did not inhibit the ability of the cells to move in over the denuded area. The degree of inhibition of mitosis

was almost exactly the same as that produced in intact epithelium. In view of this observation, it was thought advisable to study the rate of epithelization of burns in eyes which had been irradiated sufficiently in advance so that the depressing phase of the irradiation had been passed. Eight days after irradiation mitotic figures were uniformly more frequent in the treated than in the untreated cornea; in the experiments on intact eyes, therefore, this stage was selected. Both corneas of 6 rats were burned twelve hours before autopsy, and eight days after a single exposure of the right eye to grenz rays. In each case epithelization was greatly delayed in the irradiated eye. The size of the unhealed portion of the burns of the control eyes was normal for the twelve hour stage. The area of the unhealed portion of the burns of the irradiated corneas was much greater than that of the control burns. The number of mitotic figures was not depressed in 4 of the 6 animals, but a significant decrease in their number was noted in 2, namely, —41 and —66 per cent respectively. The decrease in these 2 animals was responsible for the indicated depression of mitosis shown for this group in figure 1. This depression is probably to be explained by the fact that the area of epithelium on which the counts were based was so much less in these eyes, owing to the large unhealed area of the burn. These results led us to repeat the experiment on 7 additional animals, with similar results. The burns of the eyes irradiated eight days earlier healed more slowly than did similar injuries of the control eye. Twelve hours after the burn had been made the unhealed portion of the burns of the eyes irradiated eight days earlier was 152 per cent larger than that of the control burns. This inhibitory effect was consistent, for it occurred in 12 of the 13 animals studied. The healing of corneal burns of 5 other rats which had received grenz radiation to one eye ten days earlier was also studied. In this group the average unhealed area of the burn was greater in the irradiated eyes, but the inhibitory effect was apparently wearing off, for 3 burns healed normally.

COMMENT

The grenz rays share, in common with the regular roentgen and the ultraviolet rays, the property of inhibiting cell division.[10] Although they are generally regarded as harmless to the eye, owing to their inability to

10. (*a*) Carlson, J. G., and Hollaender, A.: Immediate Effects of Low Doses of Ultraviolet Radiation of Wavelength 2537 A on Mitosis in the Grasshopper Neuroblast, J. Cell. & Comp. Physiol. **23**:157-169, 1944. (*b*) Glucksmann, A.; Tansley, K., and Wilson, C. W.: The Effect of Variations in the Dose-Rate of Gamma Radiation on Cell Degeneration in the Frog Tadpole, Brit. J. Radiol. **18**:158-164, 1945. (*c*) Buschke, W.; Friedenwald, J. S., and Moses, S. G.: Effects of Ultraviolet Irradiation on Corneal Epithelium: Mitosis, Nuclear Fragmentation, Post-Traumatic Cell Movements, Loss of Tissue Cohesion, J. Cell. & Comp. Physiol. **26**:147-164, 1946.

penetrate deeply into tissues, it is clear that the reproductive capacity of the irradiated superficial cells is greatly impaired for a relatively long time. It is important to note that the single dose used in these experiments was not excessive, but within the range given for therapeutic purposes.

The long, five day, inhibition caused by a single exposure to the rays was followed by a very short period in which mitotic figures were more frequent in the treated eye. This increase in mitosis, although consistent, was not much more than might be accounted for by normal variations. That the increase was certainly not great enough to make up for the five day deficit in mitosis is obvious on reference to figure 1. If the cell population remained constant during this period, the rate at which the cells died and were lost must also have greatly decreased.

From a biologic point of view, a most interesting condition is apparent. The two processes involved in healing, mitosis and cell migration, are not equally affected. The burns studied healed, as nearly as could be determined, at the normal rate while under the influence of an agent which reduced mitosis nearly 100 per cent. Similar, although not as striking, evidence of the separateness of these two phases was noted earlier in experiments with the effect of anesthetics on wound healing.[11] Buschke, Friedenwald and Moses [10c] also noted that ultraviolet radiation in amounts which inhibited mitosis did not deter posttraumatic cellular movements. There is no evidence that grenz rays inhibit processes necessary to protoplasmic movement involved in cell division, for no inhibition of mitotic activity was noted in those cells which had entered the active phases of this process, nor was cell migration following injury inhibited shortly after an irradiation.

There was no indication of a beneficial effect of grenz rays on either of the healing processes studied. Cell migration was at best not affected, whereas mitosis was definitely inhibited for several days after exposure to grenz rays. The experiments of Buschke, Friedenwald and Moses [10c] on the effect of ultraviolet radiation on mitosis showed that with weak doses mitosis was stimulated. A similar reaction was not noted with grenz rays when shorter exposures were given.

SUMMARY

1. Single exposure to grenz rays (410 r) greaty inhibited cell division in the corneal epithelium of the rat for approximately five days.

2. The period of inhibition was followed by a short interval in which a slight rise in the number of mitotic figures occurred. This increase in

11. Smelser, G. K., and Ozanics, V.: Effect of Local Anesthetics on Cell Division and Migration Following Thermal Burns of the Cornea, Arch. Ophth. **34**:271-277 (Oct.) 1945.

mitosis was not sufficient to compensate for the five day deficit in cell division.

3. Grenz rays did not affect cell division once the cells had entered the active stages of mitosis.

4. Grenz rays had no effect on the rate of epithelization of thermal burns made within six days of the irradiation.

5. Thermal burns made eight days after a single irradiation healed more slowly than normal in 12 of the 13 animals studied. This inhibitory effect was conspicuously less by the tenth day after irradiation.

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INTRAMURAL VASCULAR SYSTEM (VASA VASORUM?) IN RETINAL VESSELS

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GLASGOW, SCOTLAND

VESSELS within the wall of retinal vessels have not hitherto been recognized. In general, only the walls of vessels with a caliber greater than 1 mm. are provided with vasa vasorum, the latter arising from adjacent small arteries and forming a dense capillary network in the adventitia. Even in larger arteries they do not penetrate farther than the external layers of the media. They are more abundant in the veins and here penetrate deeper, into the intima, and may even drain the lumen (Maximow and Bloom [1]).

In studying the retina in bulk after clearing in glycerin, I have, however, observed capillaries in the walls of diseased retinal vessels (Loewenstein,[2] 1946). I supposed at first that this capillary system represented unknown vasa vasorum, and therefore for years I hesitated to publish my results. It was not until I came across the work of Winternitz, Thomas and Le Compte,[3] entitled "Biology of Arteriosclerosis," that I understood my observations. These authors, using the clearing method in the study of pathologic tissue, were able to prove the existence of an intramural vascular system in the sclerosed aorta and in sclerosed coronary arteries. They stressed the importance of the presence of this rich vascular system in the intima within and around arteriosclerotic plaques. It is not less significant that this network was not observed in healthy vascular walls in young persons. Only in areas where these intramural vessels bridged a narrowed or occluded lumen might they pass through healthy tissue in the vascular walls to reach the affected parts. These authors observed the intramural vascular system within the diseased venous wall no less frequently than in the arterial wall, it being sometimes even highly developed

From the Tennent Institute, University of Glasgow; Prof. W. J. B. Riddell, Director.

1. Maximow, A. A., and Bloom, W.: A Textbook of Histology, ed. 3, Philadelphia, W. B. Saunders Company, 1938.

2. Loewenstein, A.: Read at the meeting of the Oxford Ophthalmological Congress, July 5, 1946.

3. Winternitz, M. C.; Thomas, R. M., and Le Compte, P. M.: The Biology of Arteriosclerosis, Springfield, Ill., Charles C Thomas, Publisher, 1938.

in veins. Enlightening to the ophthalmologist is a picture produced by these authors of the narrowed lumen of a renal artery with a rete mirabile forming a collateral channel system (page 77, fig. 61 [8]).

. . . The significance of this collateral circulation may be very great where other routes are not available or insufficient in capacity, as for instance in the so-called end arteries of the coronary system.

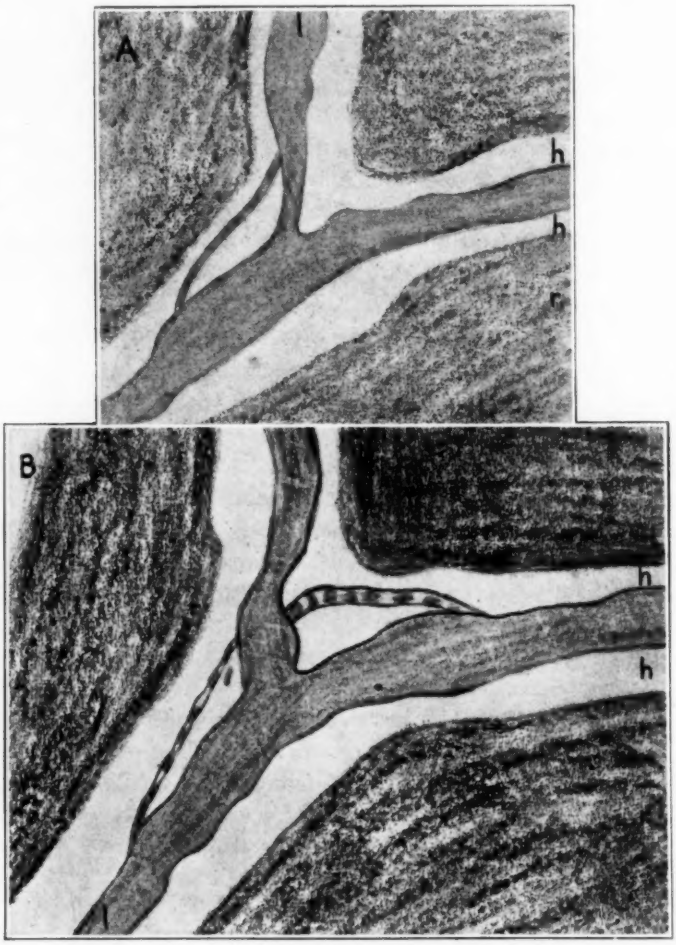


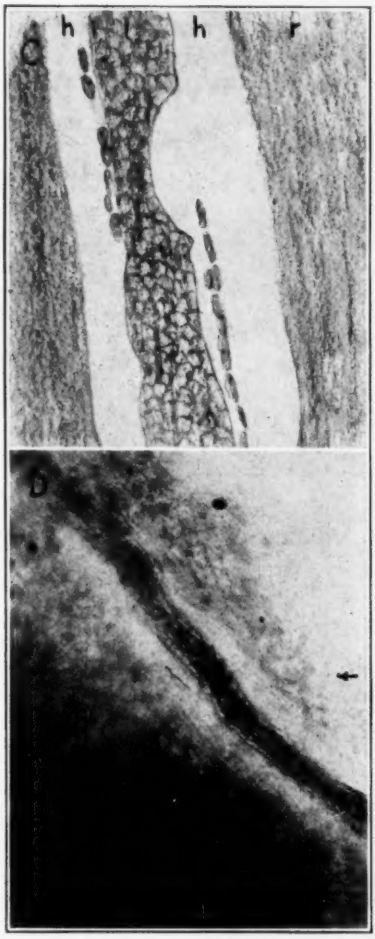
Fig. 1.—*A*, intramural capillary in the hyalin-thickened wall at a branching point. Retina in bulk; × 250.

In this drawing, and in *B* and *C*, *l* indicates the lumen; *h*, the hyalinized wall of the vessel, and *r*, retinal tissue.

B, intramural capillary in the hyalin-thickened wall of a retinal vessel in a case of thrombosis of the central retinal vein. Retina in bulk, unstained; × 250.

The ophthalmologist in reading this description is strongly reminded of changes in the fundus associated with thrombosis of the retinal branch

vessels, with arteriosclerotic and diabetic retinopathy and with so-called retinal periphlebitis. The similarity of this ramified intramural vascular system in diseased coronary arteries to a retinal or a preretinal rete mirabile is striking.



C, intramural capillaries in the sclerosed wall of a retinal vessel in a case of thrombosis of the central vein. Retina in bulk, unstained.

D, photograph of the retina in bulk, unstained (× 107) in a case of thrombosis of the central vein, showing an intramural capillary (arrow) remaining in focus.

Paterson [4] (1936) had described vascularization of coronary arteries in association with atherosclerosis. He did not observe these intramural vessels in normal arteries or in arteries with early nodular endarteritis.

4. Paterson, J. C.: Vascularization and Hemorrhage of Intima of Arteriosclerotic Coronary Arteries, Arch. Path. **22**:313 (Sept.) 1936.

They were particularly conspicuous in thrombosed coronary arteries. It is significant that he noted these intimal capillaries in close proximity to extravasated blood. This observation was confirmed and its importance indicated by Winternitz and his co-workers.[5] Paterson showed that these intimal capillaries arise not from the adventitial vasa vasorum but from the lumen of the partially occluded vessels. They may develop in response to nutritional requirements associated with the sclerosed plaque.

Paterson stated that Robertson,[5] in 1929, had already seen a discrete capillary system in the intima of the diseased ascending aorta. Leary [6] (1934) described proliferating intimal capillaries in 4 out of 21 cases

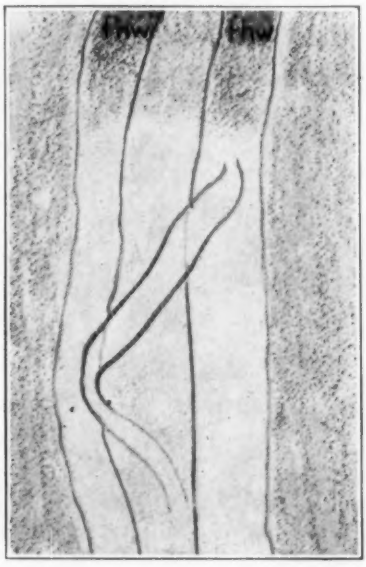


Fig. 2.—Retinal arteriosclerosis, with an empty intramural vessel running spirally. The fatty hyaline wall is indicated by *fhw*. Retina in bulk, stained with scarlet red; × 112.

of coronary thrombosis. In 1 case a capillary showed an opening into the lumen.

INTRAMURAL VASCULARIZATION OF SCLEROSED RETINAL VESSELS

My co-workers and I have observed single capillaries running within the hyalin-thickened wall of sclerosed retinal vessels. When they are filled with blood, these capillaries stand out sharply in the glycerin-cleared, unstained retina in bulk (fig. 1 *A*, *B* and *C*). They are not easy

5. Robertson, H. F.: Vascularization of Thoracic Aorta, Arch. Path. **8**:881 (Dec.) 1929.

6. Leary, T.: Experimental Atherosclerosis in Rabbit Compared with Human (Coronary) Atherosclerosis, Arch. Path. **17**:453 (April) 1934.

to distinguish when they are empty, as their walls are extremely thin. They rarely remain at one level. The sketches have been made, therefore, with constant change of focus, this variability of level being the reason that my attempts to get satisfactory photomicrographs have generally been unsatisfactory (fig. 1). It is even more difficult with empty intramural vessels (fig. 2). Sometimes I found a suitable intramural vessel running for a short distance at the same focus (fig. 1 *D*). The contrast with the surrounding tissue was slight, and no distinction appeared on the ground glass of the microcamera. (Figure 2 was taken with the stereomicroscope; the capillary was not discovered with the microcamera.)

The majority of the intramural vessels run parallel with the lumen (fig. 1 *A, B, C* and *D*). They are more frequent at points of bifurcation (fig. 3). These intramural capillaries are observed in retina in bulk

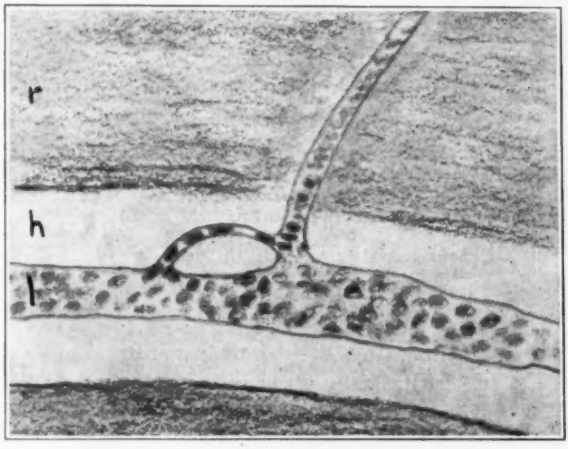


Fig. 3.—Hypertensive retinopathy with thrombosis of the central retinal vein, showing unusual branching. Retina in bulk, unstained; × 240.

more easily if they do not run above or below the blood-filled lumen, but course tangentially, thus appearing in a deep, clear hyaline layer (fig. 4), which provides sufficient contrast.

The opening of these capillaries into the lumen is difficult to demonstrate in bulk specimens but easy in serial sections (fig. 5). This is also true of their branching, which was not seen with sufficient clarity in whole thickness specimens of the retina but could be shown easily in serial paraffin sections (fig. 6).

We observed intramural vessels within the hyalin-thickened vascular wall running obliquely (fig. 2), as well as vessels with a circular course, but the latter were less frequent than the vessels running longitudinally. In most cases the circular capillaries could be traced through half the circumference of the vessel (fig. 7 *A, B* and *C*). We were unable to

distinguish origin and outlet in bulk specimens, but serial sections permitted reconstruction of the connection between the lumen and the adjacent retinal vessel. Here we could follow the opening into the lumen (fig. 6), trace the division within the hyaline coat and even demonstrate reunion with the sister branch. This is proof of a modest

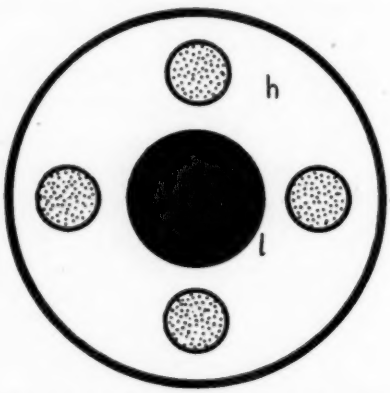


Fig. 4.—Schematic sketch of intramural vessels in a hyalinized wall, seen in the retina in bulk. The vessels are practically invisible when in front of or behind a filled lumen. They stand out sharply when seen tangentially. The hyaline wall is indicated by *h*; the blood-filled lumen, by *l*.

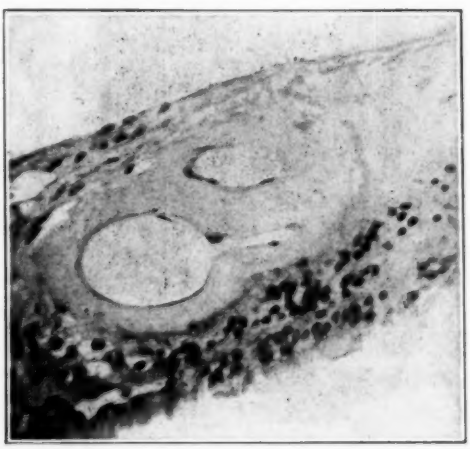


Fig. 5.—Intramural vessels with intramural sprouting. Hematoxylin and eosin stain; × 300.

network. A spiral intramural course could be shown as well (fig. 8). Interesting is the appearance of parallel vessels, the lumens of which are separated by one endothelial layer only (fig. 9). We measured the length of this parallel course and found it to be from 100 to 160 unicrons.

This is a peculiar vascular arrangement, the significance of which is as yet obscure. It is never observed in normal retinal twigs. We noted frequently that the site of origin of the intramural vessels in the intima was surrounded by a group of endothelial nuclei. This observation may also have significance. The phenomenon is reminiscent of the sprouting of endothelial cells in growing embryonic capillaries. A cellular

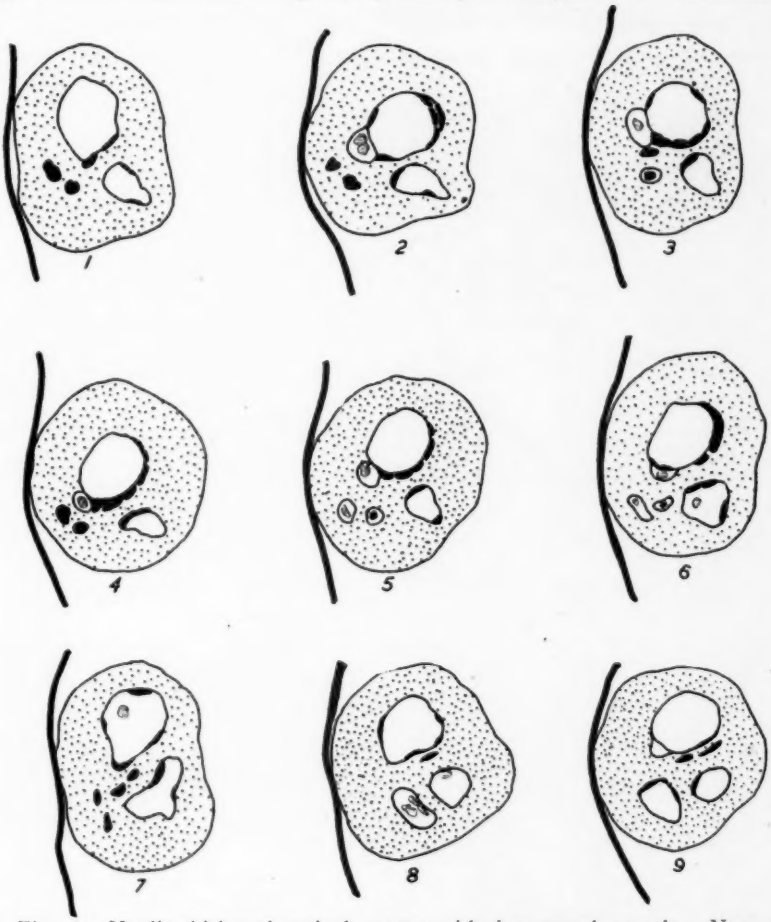


Fig. 6.—Hyalin-thickened retinal artery with intramural vessels. Note the intramural capillaries and their relation to endothelial nuclei. Some of the cross sections contain red blood cells. The capillaries unite and divide again, producing an intramural network. Hematoxylin and eosin stain; × 160.

protrusion appears on the wall of the budding vessel, frequently in the form of a pointed cylinder. Maximow and Bloom [7] explained this embryonic budding on the basis of the increased demand of embryonic metabolism.

7. Maximow and Bloom,[1] p. 266.

The intramural vessels are predominantly capillaries. Rarely one encounters an appearance like that in the section shown in figure 10, in which we observed a vessel running parallel to the main lumen, separated by an endothelial layer. But we were unable to find an endothelial lining in the smaller, blood-filled lumen of the unstained bulk specimen. Thus, we came to the conclusion that a kind of dissecting aneurysm was responsible for the production of this blood-filled canal, which was connected with the main lumen of a vascular bridge (fig. 10). Serial

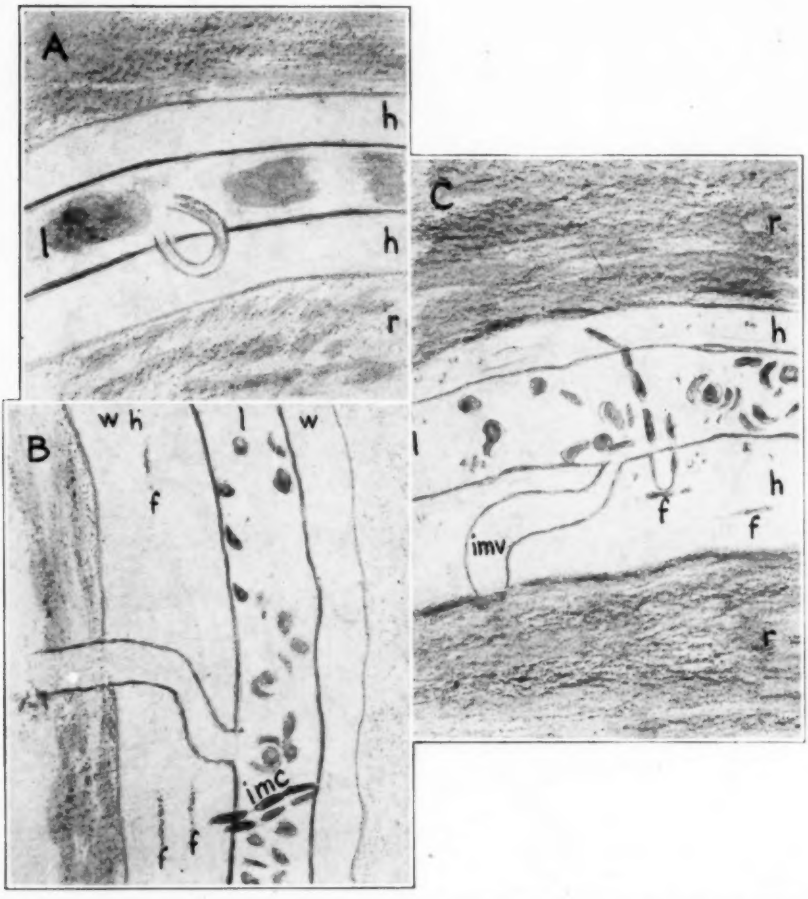


Fig. 7.—*A*, intramural capillary running in circular fashion within the hyalin wall. Fat droplets appear in the wall of the intramural vessel. Retina in bulk; scarlet red stain; × 275.

Here, *h* indicates the hyalin wall; *l*, the lumen, and *r*, retinal tissue.

B, atheroma of retinal arteries, with asymmetric thickening of the wall (*w*) and ring-shaped intramural capillary (*imc*). Fibroblasts (*f*) contain fatty granules. Retina in bulk; scarlet red stain.

C, hypertensive retinopathy. Note the empty intramural capillary (*imv*) running across the hyaline vascular wall (*h*). The lumen is indicated by *l*, and the retinal tissue, by *r*. Retina in bulk; scarlet red stain; × 275.

paraffin sections proved, however, that the "dissecting aneurysm" was a real intramural vessel. An endothelial lining was observed in the stained section.

The metabolism of a hyalinized vascular coat might be disturbed locally. The derivation of nourishment directly from the blood stream would meet with difficulties, which might be overcome by the budding of new capillaries from the endothelium. The growing intramural

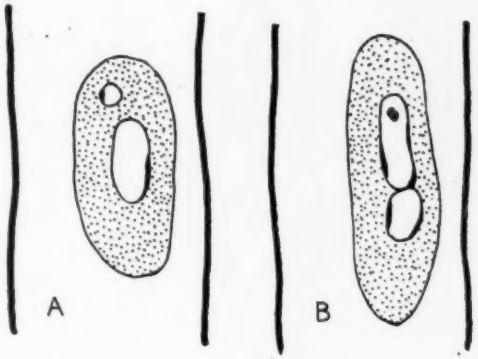


Fig. 8.—Hyalin-thickened vessel in a case of hypertensive retinopathy. One intramural vessel is followed in the series for 160 microns and runs in a spiral from *A* to *B*, where it unites with the main lumen. Hematoxylin and eosin stain; × 175.

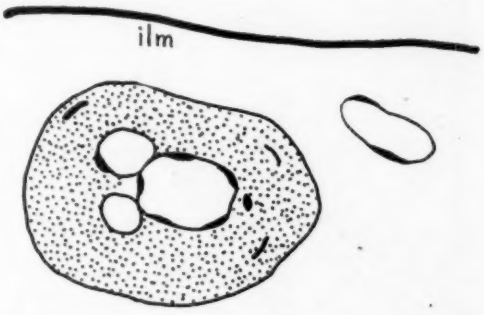


Fig. 9.—Hyalin-thickened retinal vessel. Two intramural vessels run close to the main lumen for 60 microns. Here, *ilm* indicates the internal limiting membrane; the drawing represents the entire retinal thickness. Hematoxylin and eosin stain; × 190.

capillaries represent an emergency blood supply for a nutritionally menaced area.

We found newly formed intramural vessels in hyalinized arteriosclerotic vessels of the retina and concluded that the hyaline change is characteristically associated with this kind of vascular disease. Lately, however, we discovered a case of subendothelial fatty necrosis, a typical atheroma (fig. 11), with a widespread intramural vascular sys-

tem. Atheromatous changes within the retinal vessels are, therefore, not free from the formation of intramural vessels, as Winternitz and co-workers have shown in the coronary system.

The extent of the intramural vessels is, of course, far more limited than that of the extramural ones, which may produce a rich intraretinal

Fig. 10.—Hypertensive retinopathy, showing with large intramural vessel (*imv*) with branching toward the main lumen (*l*). Unstained retina in bulk.

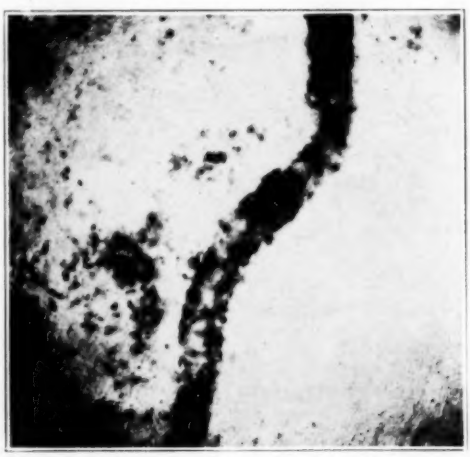


Fig. 11.—Atheromatous changes in a retinal artery consisting in fatty subendothelial necrosis, with many intramural vessels in its course. Retina in bulk; scarlet red stain; × 60.

and/or preretinal network. This rete mirabile is encountered frequently in cases of diabetic retinopathy (Ballantyne and Loewenstein [8]) and

8. Ballantyne, A. J., and Loewenstein, A.: Pathology of Diabetic Retinopathy, Tr. Ophth. Soc. U. Kingdom (1943) **63**:95, 1944

in cases of occlusion of the central vein, especially if the closing process proceeds slowly, with sufficient time for the production of an emergency blood supply. Such a rete is impressive in bulk specimens of the retina as the blood stain within this network penetrates the capillary wall (fig. 12*A*).

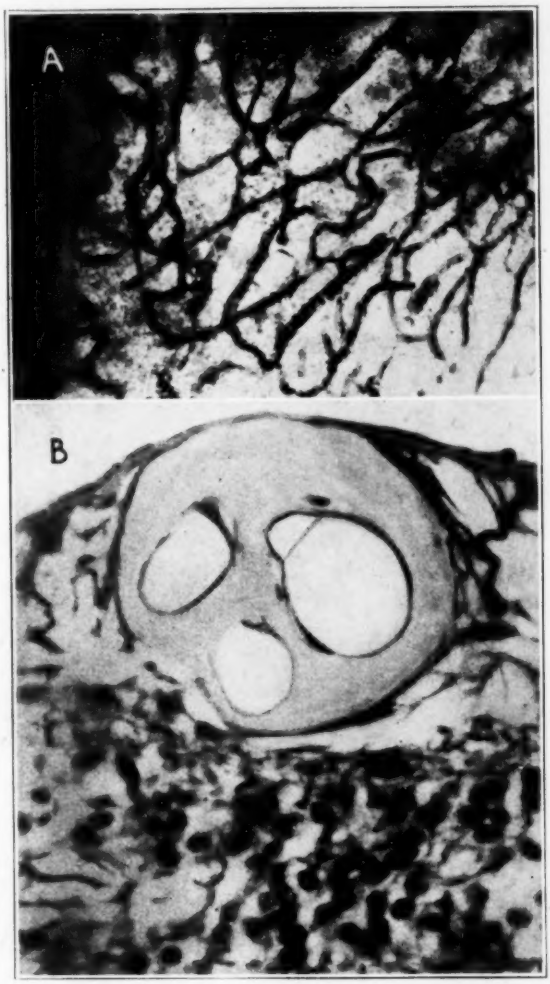


Fig. 12.—*A*, extramural new-formed capillaries in different layers of the retina in a case of thrombosis of the central vein. Retina in bulk, unstained; × 150.

B, intramural vessels in a case of retinal arteriosclerosis. Paraffin embedding; hematoxylin and eosin stain; × 30.

Knowing of the existence and appearance of intramural vessels in the arteriosclerotic vascular system of the retina (fig. 12*B*), I studied routine sections of pyroxylin-embedded eyes in cases of arteriosclerotic

vascular changes. I encountered evidence of an intramural vascular system in many slides. Figure 13 is a section from an eye of a man aged 74 with arteriosclerosis which was excised after expulsive hemorrhage in the course of cataract extraction. Many small vessels within the hyalin-thickened wall of the central artery are to be seen in the sections. (No study of serial sections was carried out in routine examinations.)

In a case of atheromatosis in an 11 year old boy with very high blood pressure and an aneurysm of the basal meningeal artery, we were unable to discover intramural vessels, in spite of far-reaching changes in the vascular coat. This absence of intramural capillaries in young persons may be significant.

In a case of thrombosis of the central vein with secondary glaucoma in a woman aged 41 there were a great mass of hemorrhages in all layers of the retina, a large number of microaneurysms and pronounced

Fig. 13.—Intramural vessels (central retinal artery) in a case of expulsive hemorrhage occurring during cataract extraction, observed in routine sections. Hematoxylin and eosin stain; × 280.

thickening of the coats of arteries and veins. Intramural capillaries were numerous in the retina in bulk. Routine pyroxylin-embedded sections (fig. 14) revealed a large number of intramural vessels, many of them being filled with blood. It was easy to differentiate an intramural hemorrhage (fig. 14 *B*) from an intramural capillary. In intramural hemorrhages no, or few, red blood corpuscles are deformed, most of them retaining their normal shape. In intramural capillaries (fig. *A* and *B*) seen in bulk specimens, however, the red blood corpuscles are greatly deformed, the cross diameter being about one-fourth the longitudinal one. This deformity, according to Krogh,[9] is due to the active constriction of

9. Krogh, A.: The Anatomy and Physiology of Capillaries, New Haven, Conn., Yale University Press, 1922.

the capillary. Hemorrhages from these capillaries were observed by Winternitz and co-workers,[3] who stressed the pathognomonic importance of the condition. Paterson noted hemorrhages in the intima of coronary arteries associated with the intimal capillaries. He concluded that the primary process was endarteritic, and then vascularization of

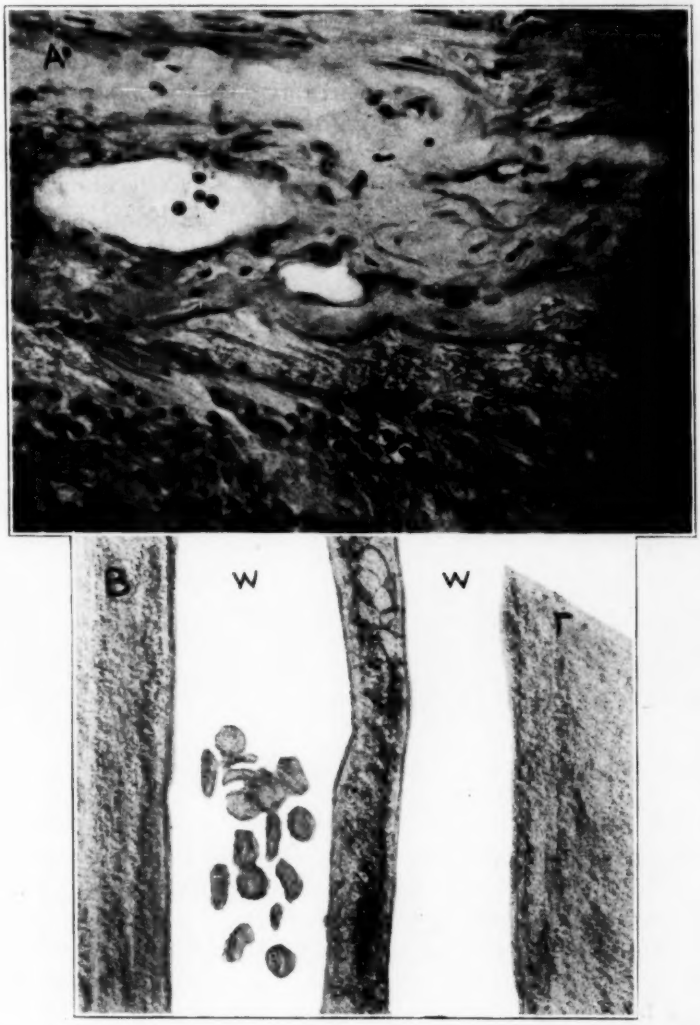


Fig. 14.—*A*, hyalin-thickened vascular wall with many intramural capillaries in a case of thrombosis of the central retinal vein. The vessels had been observed before in clear, unstained specimens of retina in bulk. Paraffin-embedded section; hematoxylin and eosin stain; × 300.

B, hypertensive retinopathy, showing hyalin-thickened arterial wall, with hemorrhage within the tissue of the wall. There is no deformation of the red blood corpuscles. Retina in bulk, unstained; × 675. In this drawing *r* is the retinal tissue, and *w*, the thickened vascular wall.

the intima occurred, followed by softening of the surrounding stroma, until, finally, the capillary ruptured. We observed capillary hemorrhages in a case of combined hypertensive and diabetic retinopathy (fig. 15). They were frequent in 2 cases of vasculitis retinae.

In flat, unstained retinal specimens (fig. 16) fine channels ran parallel to the blood-filled central lumen. Some regular capillaries were conspicuous and sharply delineated. In other places a far more irregular system of capillary channels had replaced the main vessel (fig. 17). In serial sections (fig. 18) these vessels appeared to contain a multitude of endothelium-lined lumens, separated by a nucleated granular substance, in which lymphocytes, epithelioid cells and fibroblasts were visible. The presence of so many spaces produced a sievelike appearance in cross section. Some of these vessels were filled with blood; some were empty. Serial sections showed that these vessels communicated

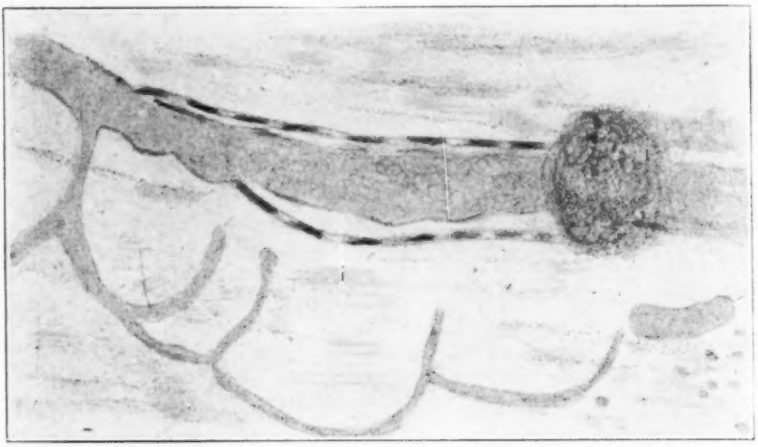


Fig. 15.—Two intramural vessels vanishing in a retinal hemorrhage in a case of hypertensive and diabetic retinopathy. Retina in bulk, unstained; × 266.

freely with each other. At first, we concluded that the process represented a primary thrombotic occlusion which had been canalized by the newly formed vessels. But study of slides in which the "thrombus" filled a part of the lumen only revealed that the intima covered the vascularized tissue without interruption. It is doubtful, therefore, whether this tissue is to be called a thrombus or whether it may better be considered a thickening of the wall due to a disease process.

Duguid [10] revived an old theory proposed by Rokitansky (1852) concerning sclerotic thickening of the arterial wall. He expressed the belief that the subjacent endothelium disappears when a thrombus

10. Duguid, J. B.: Thrombosis as Factor in Pathogenesis of Coronary Atherosclerosis, J. Path. & Bact. **58**:207, 1946.

forms on the wall of an artery. A new lining of endothelial cells grows over the exposed surface of the thrombus. Thus, the thrombus becomes subendothelial in position and a part of the wall of the vessel.

This process may have taken place in the "thrombosed" retinal vessel in a case of vasculitis retinae which my associates and I reported (Loewenstein, Michaelson and Hill[11]). The mural disease may have caused the establishment of a thrombus, with vanishing endothelium at the site of adhesion and production of a new endothelial covering of the thrombus. The thrombus becomes incorporated in the wall of the vessel and is vascularized by newly growing capillaries from the lumen, as described in other instances of intramural vessels.

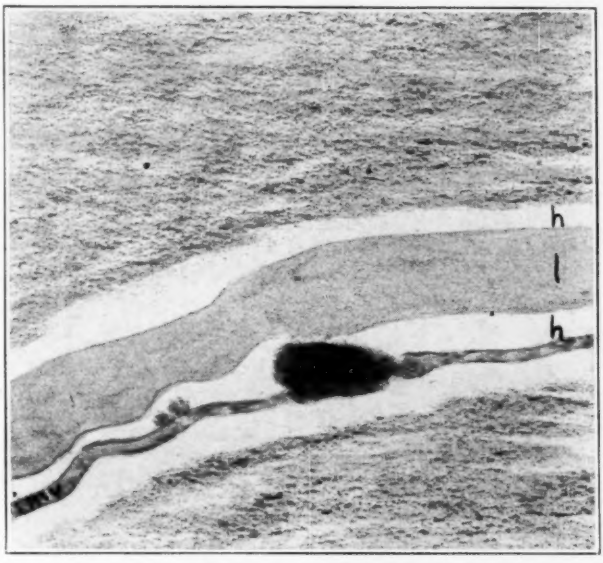


Fig. 16.—Intramural vessel with an intramural hemorrhage in a case of vasculitis retinae. Here, *l* indicates the lumen; *h*, the asymmetrically thickened hyaline wall, and *i m v*, the intramural vessel. Retina in bulk, unstained; × 300.

As already noted, the intramural vessels for the overwhelmingly greater part of their course remain within the hyalinized wall, whether they run parallel to the lumen, in circles or in spirals. Obviously, they serve the nutrition of a diseased tissue. Whereas the metabolism of the normal wall of the small retinal vessels is sufficiently maintained by the blood stream in the lumen, the diseased vessel wall, the hyalin-thickened coat especially, demands more nourishment. It may be that the changed consistency of the tissue acts as an impediment to the movement of fluid, filtration of which is rendered more difficult. It is likely that oxygen

11. Loewenstein, A.; Michaelson, and Hill: Read at the meeting of the Ophthalmological Society of the United Kingdom, May 30, 1946.

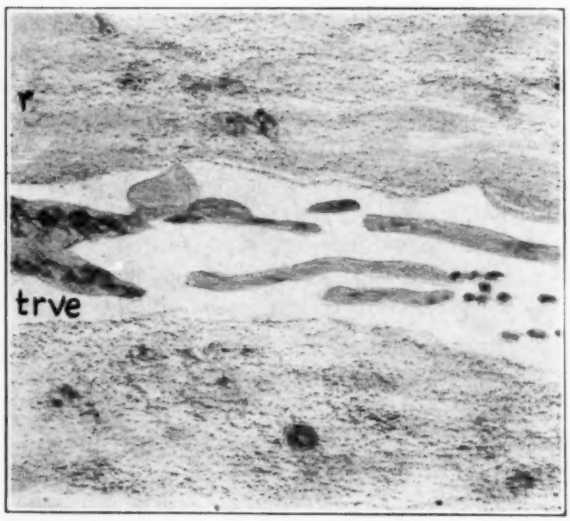


Fig. 17.—Thrombosed vessel with a multitude of new-formed, blood-filled channels (canalized thrombus?) in a case of vasculitis retinae (compare figure 18). Here, *r* indicates retinal tissue, and *t r v c*, thrombotic and canalized retinal vessel. Retina in bulk, unstained. × 257.

Fig. 18.—Vessel in the anterior part of the retina filled with a granulomatous tissue and perforated like a sieve with many thin-walled vessels. Paraffin embedding; hematoxylin and eosin stain; × 300.

tension and lack of nutrition are responsible for the stimulation to formation of additional blood vessels. We believe that deficit metabolism of the hyaline tissue of the wall may supply the stimulus.

Under similar conditions, the metabolism of avascular corneal tissue is sufficient for all normal occasions. When the nutritional supply decreases, as in an inflammatory process, the damaged tissue calls for nutritional aid, and gets it from the nearest vascularized area, i. e., the limbus, in the form of newly formed vessels.

Winternitz and co-workers [3] stressed the factor of the blood. If the lumen is narrowed, the nutritional capacity of the blood may become inadequate. They suggested that materials then exist in the blood which are potent stimuli for endothelial and capillary growth. The two factors may work together.

An interesting point is the tendency of the intramural capillaries to bleed. Paterson pointed out, correctly, that normally the intracapillary pressure is much less than the blood pressure in the aorta. The intramural vessels may rise from the lumen of the aorta, under the aortic blood pressure, which is about twice the normal capillary pressure. These intramural capillaries consist of a simple endothelial layer; they may, therefore, easily rupture.

COMMENT AND CONCLUSION

Study of unstained retinal specimens cleared in glycerin has proved that capillaries are present in many sclerosed vascular walls. These intramural vessels may run parallel to the lumen or in circles or spirals. Examination of serial sections showed that the majority of the intramural vessels can be demonstrated to arise from the lumen, and that many of them may have a connection with another opening into the lumen. Others drain into extramural retinal vessels.

These vessels are different from normal twigs, as they leave the lumen closely attached for the most part to the endothelial lining of the lumen and remain for a considerable distance within the wall. Intramural ramification is the rule. Their wall consists of simple endothelium. Hemorrhage into the diseased wall from these intramural vessels is frequent, especially in cases of vasculitis retinae. I have not yet observed intramural retinal vessels in normal eyes, but they were discovered on reexamination of routine sections of eyes of patients with a sclerotic vascular system.

New formation of vessels in the diseased retina is a well known fact and frequently has been observed intraretinally and preretinally, on both ophthalmoscopic and anatomic examination. The existence of intramural newly formed retinal vessels has not hitherto been recognized. Their presence in vessels of such small caliber is surprising. They seem

to serve to improve a disturbed nutrition of the walls. New vessels in the coat of the diseased aorta and coronary arteries were described by Robertson [5] (1929), Leary [6] (1934) and Paterson [4] (1936) and were widely discussed by Winternitz, Thomas and Le Compte [3] (1938), who stressed the pathologic significance of these vasa vasorum in the intima of the diseased coronary arteries and aorta. The intramural vessels may serve to transport blood over an occluded or narrowed part of the lumen.

In general, such a process may perhaps be regarded as an attempt at healing of, or as compensation for, a locally diseased part of the vascular wall.

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STEREOSCOPE AS TRAINING INSTRUMENT

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THE BREWSTER STEREOSCOPE AND MODIFICATIONS

THE FAMILIAR forms of the Brewster stereoscope consist of a pair of plus lenses decentered outward and mounted to permit convenient viewing of a pair of stereoscopic pictures through the lenses. These pictures have usually been set near the focal plane of the lenses to increase the illusion of distance by encouraging relaxation of accommodation and convergence.

Accommodation is relaxed and the lines of sight are parallel when two conditions are satisfied: when the targets are in the focal plane of the lenses, and when the centers of the targets for the two eyes and the optical centers of the viewing lenses are separated by the same distance. It is apparently the latter condition which accounts for the usual decentering of the lenses, for it permits the use of larger pictures.

When the stereoscope is used as a training device, it is customary to move the targets forward or backward to stimulate changes in accommodation. Demands on convergence have been changed by introducing different distances between the centers of the targets for the two eyes. An extension of this type of control is represented in the separate mounting of the pictures for the two eyes in holders which can be moved apart to provide any desired amount of separation between target centers.

A further development of these possibilities is represented by simultaneous change in the separation of the targets and in their distances from the lenses, as proposed by Dr. Samuel Renshaw, of Ohio State University. In the "stereo-disparator," which Dr. Renshaw has designed, the targets may be moved along paths which are parallel to the midline of the instrument, as in the usual stereoscopes, or they may be moved along paths inclined toward the midline. The relations of these target paths to the demands made on accommodation and convergence are the subject of the present study.

ORTHOPTIC VIEWING WITH THE BREWSTER STEREOSCOPE

It has already been indicated that the accommodation and convergence of emmetropic, orthophoric observers are both relaxed, as for viewing objects at a distance, when stereoscopic targets are placed in the focal

plane of the lenses so that the distance between the centers of the targets is the same as the distance between the optical centers of the two lenses. Proof of this statement follows.

The image of a point will lie on a line from the object point through the optical center of the system, that is, in this case, from the center of the target, C, through the optical center, L, of the viewing lens of

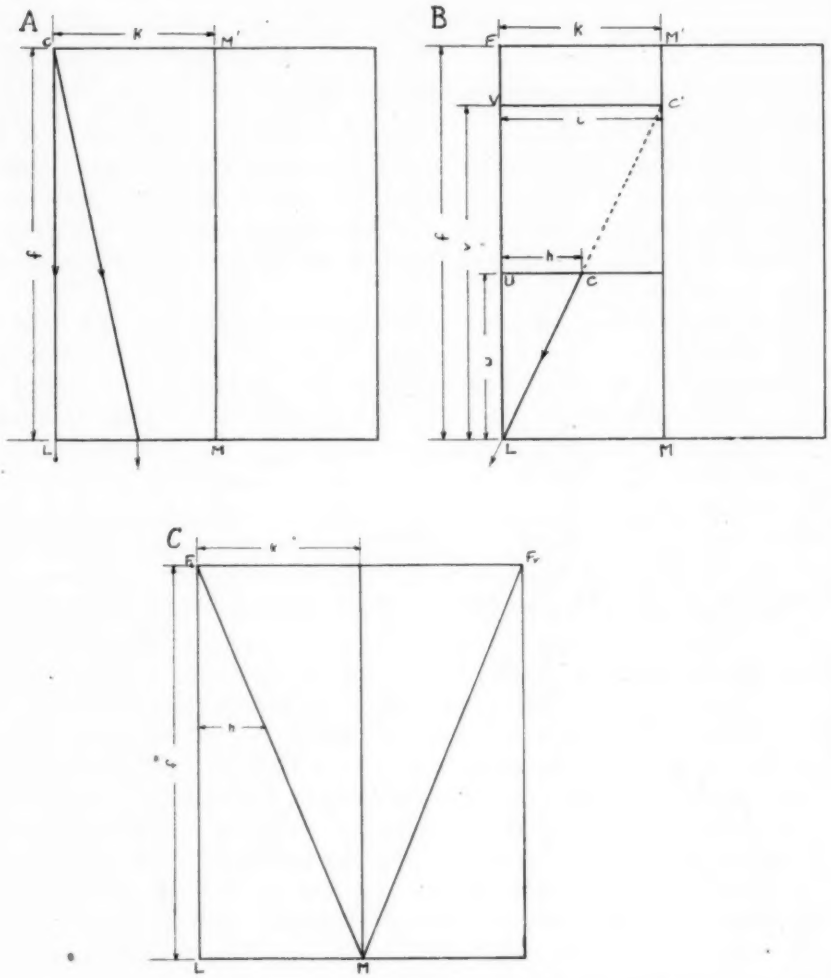

Fig. 1.—*A*, orthoptic viewing with the target in the focal plane. If the optical center of the viewing lens is at k centimeters from the midline of the instrument, the target center, C, must also be k centimeters out from the midline.

B, orthoptic viewing with accommodation in play. Light from the target center, C, at u meters from the plane of the lenses emerges as if originating at C', on the median line at v meters from the plane of the lenses.

C, target paths for orthoptic views, F_1M and F_2M.

the stereoscope. When the target center and the center of the lens are at equal distances from the midline of the instrument and the target is in the focal plane, this line is parallel to the midline of the instrument, as shown in figure 1 *A*. Since all other rays from the same object point will emerge parallel to the ray thus represented when the target is in the focal plane of the lenses, all rays from the central fixation point will emerge parallel to the midline of the instrument, and any pair of eyes will assume the straight-ahead position in fixating the center of the picture binocularly, regardless of interpupillary distance. This is, of course, the orthophoric position for fixation of distant objects.

Precise description of the positions of the targets required for orthoptic viewing at nearer distances involves consideration of the elementary principles of optics. When stereoscopic pictures are viewed through the stereoscope, it is the virtual images of these targets which determine the direction of the lines of sight and the amount of accommodation called into play. If the central points of the two virtual images coincide on the median line of the system at some distance nearer than infinity, the demands on accommodation and convergence are related just as they normally are in viewing actual objects. Since the stereoscopic lenses are of the same power, the images will fall in the same plane when the two targets are in the same plane, and the accommodation, *A*, called into play will be inversely proportional to this distance, measured in meters.

Similarly, since the centers of the two lenses are at equal distances, *k*, from the midline, the centers of the two images will coincide on the midline only when the targets are equally displaced toward the midline from the optic axes of the two lenses. The exact amount of the displacement required is dependent on the distance of the targets from the plane of the lenses, as shown in the following discussion.

In figure 1 *B* let *C* be the center of the left target, which is at a distance of *u* meters from the plane of the lenses. Let *v* meters represent the distance of the image from the plane of the lenses. This distance can be calculated from the familiar lens formula:

$$\frac{1}{v}=\frac{1}{u}+\mathrm{D}$$

where *D* represents the dioptric power of the stereoscope lens.

Distances measured to the left of the lens when light is traveling from left to right are conventionally regarded as negative in sign, but difficulties can be avoided if one disregards this convention and substitutes negative signs in the lens formula for object-image distances, as follows:

$$-1/v=-1/u+\mathrm{D} \qquad (1)$$

The center of the image, *C'*, can then be located by projecting the line *LC*, from the center of the viewing lens through the center of the

target, to its point of intersection with the image plane at v meters from the lens.

In the similar triangles *LCU and LC'V*, thus formed, let h represent the displacement of the target center, C, from the optic axis, and let i represent the corresponding displacement of C'. Then,

$$h/i = u/v \qquad (2)$$

The condition for orthoptic viewing is fulfilled whenever $i = k$ for the two images, since k represents the distance from the center of the viewing lens to the midline of the stereoscope, and the virtual images will then coincide in the median plane. Substituting this value for i, and replacing the value of $1/v$ in equation (2) by its equivalent value from equation (1), one has

$$h/k = u(1/u - D)$$
$$\text{and} \quad h = k\,(1 - uD) \qquad (3)$$

This formula gives the position of the target center, C, for orthoptic viewing when the target is at any distance, u meters, from the lens.

If the distance h is plotted for different values of u, it is found that all values of h fall on the straight line, F_lM of Figure 1 *C*. F_l represents the point at which the optic axis of the lens intercepts the focal plane. For this distance,

$$u = f = 1/D \text{ and, from (3), } h = o$$

M is the point on the midline in the plane of the lenses. For this point, $u = O$ and, consequently, $h = k$. A corresponding line, F_rM, represents the path for the target viewed by the right eye.

To summarize, demands on accommodation and convergence can be varied while conditions for orthoptic viewing are maintained if the targets are kept at equal distances from the lenses and follow, respectively, the paths F_lM and F_rM.

HETEROTROPIC VIEWING WITH THE BREWSTER STEREOSCOPE

When the targets are separated more or less than the distance required for orthoptic viewing, prism effects are introduced which require that the eyes assume positions of relative divergence or excessive convergence for the distance of fixation. Maddox spoke of these positions as positions of artificial exotropia or esotropia.[1]

The amount of change from the orthoptic position, measured in prism diopters, is dependent on the lateral displacement of the target from the position for orthoptic viewing and on the distance of the target from the lenses, as shown in figure 2 *A*.

If p represents the displacement of the target from the position for orthoptic viewing, the prism effect, P, measured in prism diopters, will be proportional to the ratio p/u, where p is measured in centimeters.

1. Maddox, E. E.: The Bearing of Stereoscopes on the Relation Between Convergence and Accommodation, Brit. J. Ophth. **11**:330-337, 1927.

and u, the distance of the target from the lenses, is measured in meters. If the target is displaced outward from the line FM, the effect is that of base-in prism, and excess divergence is demanded; when the target is displaced nasally, base-out effect, with an excess demand on convergence, is introduced.

If one considers convergence as representing a positive function, and divergence as equivalent to negative convergence, it is convenient to regard p as positive when representing a nasalward displacement from FM, and as negative when the displacement is outward (temporalward). The equation:

$$P = p/u \qquad (4)$$

will then give a positive value for P when the prism effect is base out, representing a stimulus to convergence, and will give a negative value for P when the effect is base in.

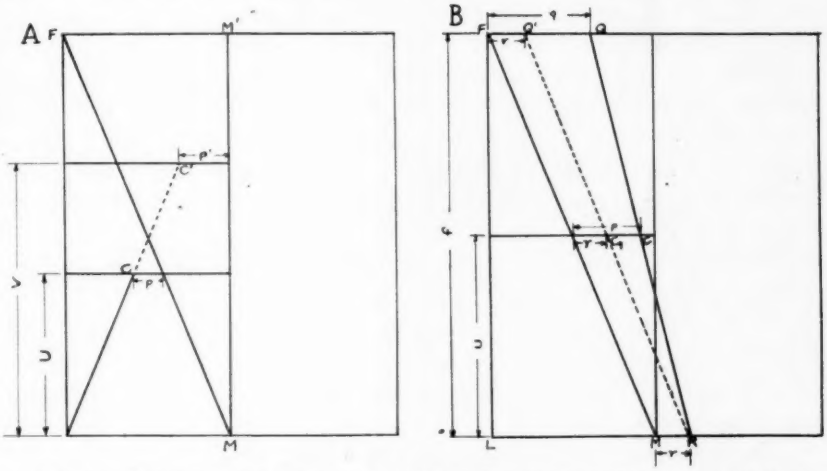

Fig. 2.—Heterotropic viewing. (A) When the target center, C, is displaced p centimeters from the orthoptic path FM, the image C' is displaced p' centimeters from the median line. (B) When the target follows the heterotropic path QR, the prism effect is determined by displacements from the orthoptic path of q in the focal plane; r in the plane of the lenses.

As the targets are moved toward the observer, or away from him, along a straight line path, the prism effect will vary, depending on the inclination of the path with respect to FM, the path for orthoptic viewing, and on its distance from this path in any given plane. The two conditions are determined if these paths for heterotropic viewing are specified in terms of the distances from F and from M at which the path intercepts the focal plane of the lenses and the plane of the lenses themselves, respectively.

The prism effect introduced when the target follows a straight line path different from the orthoptic path can be determined as follows:

In figure 2 *B*, *QR* represents such a path with displacement from the orthoptic path of q in the focal plane; r in the plane of the lenses. The target center, *C*, is displaced p centimeters. These quantities are positive when the displacement is toward the nasal side and negative when the displacement is toward the temporal side.

Q'R is drawn parallel to *FM*. In the triangles C_qRC *and* $Q'RQ$

$$\frac{p-r}{q-r}=\frac{u}{f}$$

$$\text{and} \quad p=r+(q-r)\frac{u}{f} \tag{5}$$

The prism effect, *P*, introduced when the target center is at *C*, is, from *4* and *5*,

$$P=\frac{r}{u}+\frac{(q-r)}{f}$$

Substituting values $D=\frac{1}{f}$ and $A=\frac{1}{v}=\frac{1}{u}-D$

$$P=rA+qD \tag{6}$$

Thus, for any point on any path, the prism effect of the target position can be specified in terms of the dioptric power of the viewing lenses, the direction of the path, as determined by its lateral displacements from the midline in two planes, and the demand on accommodation resulting from the distance between the target and the plane of the viewing lenses.

The general formula is correct for all cases. The only requirement is that the observer be emmetropic or wear his correction if the demand on accommodation is to be accurately represented by the value of *A*. Otherwise myopic subjects will be using less than the indicated amount of accommodation, while hypermetropic subjects will be exercising more than the amount indicated.

The interpupillary distance, which varies from one observer to another, is not a factor when the prism effect is thus considered always with reference to normal conditions of binocular fixation, here referred to as orthoptic viewing. This point of view also has the advantage of bringing the prism designation into harmony with measurements of heterophoria, convergence and divergence, since all these start with the position of orthophoria as the zero point. That is, deviations are regularly measured from the position in which the eyes are accommodated and converged for binocular fixation on a single target at any desired distance.

The simple formula thus resulting easily yields information about various target paths. For instance, the usual stereoscope provides for continuous movement of the targets only along lines parallel to the midline. When such a path starts at *F*, the focal point of the stereoscope lens, the conditions for orthoptic viewing are satisfied only when

accommodation is not in play. For all nearer positions of the target, base-in prism effect is introduced, for

$$\begin{aligned} &\text{when} && r = -k \\ &\text{and} && q = O \\ &\text{then} && P = -kA \end{aligned}$$

This amount is doubled when the two eyes are considered. Thus, if the stereoscope lenses are each decentered 5 cm. from the midline, it appears that 30 D of relative divergence would be demanded with 3 D. of accommodation for binocular fixation on targets following such paths.

For parallel paths nearer the midline, the path will cross the path of orthoptic viewing, and the decreasing demand for excessive convergence will change to an increasing demand for divergence as the target is brought nearer the observer. The point of crossing can be described as follows:

$$\begin{aligned} &P = qD + rA \\ &r = -(k - q), \quad \text{for parallel paths} \\ &P = qD - (k - q)A \end{aligned} \tag{7}$$

The expression for P becomes O at the crossing point, for which

$$A = \frac{qD}{k - q}$$

For smaller values of A, excessive convergence is required; for larger values, excess divergence is required.

Further generalizations concerning target paths can be derived from considering cases in which q and r of the general formula are, in turn, equal to zero. All paths for which $r = O$ converge toward a point on the midline in the plane of the lenses. It follows that the prism effect for all such paths remains constant regardless of the demand on accommodation, as shown in the following equations:

$$\begin{aligned} &P = qD + rA \\ &r = O \\ &P = qD \end{aligned} \tag{8}$$

for all paths converging to M.

In clinical terms, any path directed toward the midpoint of a line joining the optical centers of the two viewing lenses will provide a stimulus to a constant excess of convergence, positive or negative, and zero in the special case of the orthoptic path. The displacement required for any given effect is determined simply by solving the equation for q; that is, when

$$\begin{aligned} &P = qD \\ &q = P/D \end{aligned} \tag{9}$$

With the desired value for P, plus or minus depending on whether a base-out or a base-in effect is desired, and the known dioptric power of the stereoscope lenses substituted in this equation, the value of q is easily found, and the target path can be arranged accordingly.

For all paths for which $q = O$ (that is, which pass through the focal points of the lenses) the prism effect will vary directly with the demand on accommodation, for the equation becomes

$$P = r.A \quad \text{when} \quad q = O \tag{10}$$

This means that for all positive values of r, as accommodation is stimulated, an increasing base-out prism effect is introduced. For negative values of r, the prism effect will be base in, increasing with accommodation, as in the case of parallel paths.

If, instead of changing the target paths, one decenters the targets with respect to any single path, the effect is equivalent to changing both r and q by the amount of decentration, x centimeters. Thus, the general equation becomes

$$P = (r + x)\,A + (q + x)D \tag{11}$$

It is often advantageous to decenter the targets, as Dr. Renshaw has done with his size constancy series, because this makes it possible to bring corresponding points of the targets closer together. When it is desired to provide a strong, or even an adequate, stimulus to convergence with simultaneous strong stimulation of accommodation, the target must be decentered inward, and the consequent narrowing of the field must be accepted. Decentration of this sort is familiar with targets provided for use with ordinary stereoscopes. For instance, Sattler's *Stereoskopische Bilder für schielende Kinder* have been made only 5 cm. in breadth, instead of the 9 cm. which has become familiar through the use of the stereoscope as a simple viewing intrument.

Clinical Applications of the Stereoscope.—Maddox [1] made clear the limitations of the stereoscope as a training instrument when the separation of corresponding points in the targets does not vary as the targets are carried toward or away from the viewing lenses, that is, when the targets follow paths parallel to the midline. Noting that this arrangement always means that positive convergence is stimulated as the demand on accommodation is decreased, and that negative convergence and positive accommodation are simultaneously stimulated as the target is brought toward the observer, Maddox recommended that in cases of divergence excess or convergence weakness the target be started from a plane near the observer and then be moved outward toward the focal plane of the lenses, whereas in cases of convergence excess and divergence weakness the target should be moved toward the observer. In either case, the separation of the common elements of the two pictures is to be chosen so that the observer can fuse at the starting point, and so that he will be forced into his range of inadequate performance as the target is moved forward or backward. Krimsky [2] suggested that lenses

of different powers be inserted in the stereoscope as a means of increasing the ranges of movement forward and backward.

Maddox noted that the orthophoric position for any distance of the target is independent of the interpupillary distance, and he calibrated a stereoscope so that the orthophoric setting was shown for any given separation between target centers. Thus, he established the points ". . . beyond which convergence is greater than accommodation and within which convergence is less than accommodation," as he expressed it. The target centers must be nearer together than the centers of the lenses if this phrase is to be significant, as indicated in the preceding discussion of parallel paths. Even then, the functions of accommodation and convergence are always stimulated to respond in opposition to the normal pattern of association when targets are moved along parallel paths in exercises with the stereoscope.

This reversal of normal associations in the demands on accommodation and convergence may serve a purpose in training when it is desired to disrupt inefficient habits of accommodation-convergence association, as a step toward the substitution of more efficient associations. The usefulness of the ordinary stereoscope is limited if one is interested in encouraging positive development of efficient habits of association between these two functions.

The Renshaw modification changes this, making it possible to stimulate convergence and accommodation to respond according to the pattern required for normal conditions of viewing, or according to any other desired pattern which may seem indicated as a means of building up more adequate reserve powers in one function independently of the other. Also, emphasis may be put either on accommodation or on convergence, instead of being restricted to the type of accommodative stimulation which is associated with the desired type of convergence stimulation, as in stereoscopes of the type discussed by Maddox.

A further advantage of the Renshaw design, but one not peculiar to it, is the possibility of moving targets nearer together or farther apart without changing demands on accommodation, thus stimulating convergence quite independently of accommodation.

Thus, development of the Renshaw device makes it obvious that the full versatility of the Brewster stereoscope has not previously been utilized. As a training instrument, it was at first necessary always to stimulate accommodation and convergence simultaneously, but in an abnormal relationship, whenever considerable change in convergence was called for. Some changes could be brought about by requiring the observer to fixate successively different elements of the target design which had different degrees of disparity, but the range of movements

2. Krimsky, E.: The Stereoscope in Theory and Practice, also a New Precision Type Stereoscope, Brit. J. Ophth. **21**:161-197, 1937.

thus accomplished was very small. This limitation was partly overcome by the introduction of variable prisms, as in some of the English stereoscopes, or by providing for varying the separation of the two halves of the stereoscopic target. But the final step in this development was realized only when Renshaw proposed a means by which demands on accommodation and convergence could be varied, independently or simultaneously, and in any desired pattern of relationship. The foregoing discussion of the prism effects introduced by causing the targets to advance or recede along any selected paths, and the added effects introduced by decentration of the targets, should facilitate full utilization of this new and significant addition to the versatility of the stereoscope as a training instrument.

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NEUROLOGIC SIGNIFICANCE OF LATERAL CONJUGATE DEVIATION OF THE EYES ON FORCED CLOSURE OF THE LIDS

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IT IS the purpose of the present communictaion to note and evaluate a diagnostic sign which, although described several decades ago (in 1913, almost simultaneously by Prezzolini [1] and Bárány [2]), has received scant attention [3] in the subsequent literature. The sign, a variant of Bell's phenomenon, consists of a lateral conjugate deviation of the eyes on forced closure of the lids occurring in persons with intracranial disease.

After establishing the frequency of the sign in a series of persons with no known neurologic disease, observations were made on a group of approximately 200 persons with intracranial or labyrinthine lesions. Also noted were any evidence of paresis of conjugate gaze and any abnormality in the opticokinetic response. Eliminated from the series were patients with probable bilateral lesions of the central nervous system or the labyrinth, patients observed only in coma or only after operation (except when the operation was a labyrinthectomy), patients showing insufficient evidence to localize the intracranial lesion and patients in whom the deviation was questionable, or consisted of wandering movements, first to one side and then to the other. There remained a group of 78 patients in whom the presence or absence of the sign might be expected to have reasonable significance.

Examination for the deviation of the eyes was carried out by forcibly separating the lids as the patient attempted to close the eyes (figure). A positive result was present when both eyes turned to one side consistently. Gross paresis of conjugate gaze to one side was said to be present when the eyes could not be fully moved to that side voluntarily or when a coarse jerking nystagmus developed on the

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1. Prezzolini, M.: Deviazione coniugata dei bulbi oculari, associata alla chiusura delle palpebre, nell'emiplegia, Bull. d. sc. med., Bologna **84**:285, 1913.

2. Bárány, R.: Latente Deviation der Augen und Vorbeizeigen des Kopfes bei Hemiplegie und Epilepsie, München. med. Wchnschr. **16**:900, 1913.

3. Bárány, R.: Modern Labyrinthology, Laryngoscope **31**:401, 1921.

subject's looking to one side, with slow drifting of the eyes back toward the midline. The opticokinetic response was tested by rotating in front of the patient a 12 inch (30 cm.) drum having black figures on a white background. An abnormal, opticokinetic response was said to be present when the nystagmus produced was much less to one side than to the other or when it was not elicited at all.

The lesions were localized chiefly by symptoms and/or by operation. Few of the patients were examined post mortem, and conclusions drawn from the series must be tempered by allowance for the fallibility of symptomatic and operative localization.

RESULTS

Control Series.—Of 156 persons with no known neurologic disease, lateral conjugate deviation of the eyes with closure of the lids was observed in only 3. Deviation of the eyes up or up and out occurred in 132; no deviation from the primary position was observed in 11;

Conjugate lateral deviation of the eyes on forced closure of the lids in a patient with a tuberculoma in the left occipitoparietal region. The only ocular motor disturbances were absence of the opticokinetic response on rotating the drum to the patient's left and a spontaneous deviation of the eyes to the patient's right on attempted closure of the lids. The patient also had some hyperactivity of reflexes in the limbs, a positive Babinski sign and partial hemianopsia on the right.

convergence occurred in 5; downward deviation, in 3, and wandering movements in 2.

Cerebral Lesions.—Of the 54 patients with presumed unilateral disease of the cerebrum, 34 showed a lateral conjugate deviation of the eyes to the side opposite the lesion, 5 showed a deviation to the same side as the lesion and 15 showed no deviation, with closure of the lids.

Of the 34 patients showing deviation of the eyes to the side opposite the lesion, localization of the lesion was considered reasonably certain in all but 8. Unilateral spasticity of the extremities or a positive Babinski sign on the side toward which the eyes deviated was present in 15 of the 24 patients whose visual fields were examined. A coarse nystagmus was present in 1 patient on looking toward the side of the lesion, and reluctance to look to that side, without any definite paresis, was noted in another; the other patients showed no evidence of paralysis

of conjugate gaze. Of the 34 patients showing deviation of the eyes to the side opposite the cerebral lesion, the opticokinetic response was tested in 20. It was abnormal in 13 (defective response on rotation to the side of the lesion), normal in 7 and questionable in 1, and in 1 patient it was abnormal on one occasion but normal subsequently. The cerebral lesion had been present in the majority of patients a minimum of several weeks. The extremes of duration of the lesion were represented by a patient who was examined within twenty-four hours after the cerebral injury and by another who was examined three years after the injury. In at least 2 patients the deviation of the eyes on closure of the lids persisted longer than any other neurologic sign. Another patient, whose eyes had been examined as part of a routine work-up for suspected hypertension less than twenty-four hours prior to the vascular accident, was found to have no deviation of his eyes, but examination one week after the accident revealed the presence of the deviation.

The types of cerebral lesions represented in this series were as follows: vascular accident, 14 patients; tumors, 11 patients; injuries, 3 patients; tuberculoma, 1 patient, and undetermined type, 5 patients. The lesion involved predominantly the anterior part of the cerebrum in 6 patients, the middle portion in 7, the posterior part in 3 and the whole cerebrum or its efferent tracts in 18.

Of the 5 patients showing deviation of the eyes to the side of the lesion, the localization of the lesion was reasonably certain in 4. Some degree of spasticity of the extremities was noted in 4, and a homonymous scotoma was present in 1 of the 3 patients on whom field studies were made. Conjugate paresis of gaze was not observed in any of the patients. There was no definite relation between its presence or absence and the opticokinetic response. In all patients of this group the lesion had been present for a minimum of several weeks.

Of the 15 patients with presumed unilateral cerebral lesions who showed no deviation of the eyes, the localization was considered reasonably certain in 9. Some spasticity of the extremities was noted in 10, and homonymous scotomas (either positive or negative) were observed in 4 of the 12 patients on whom studies of the field were made. Gross paresis of conjugate gaze was not observed in any of the patients. There was no consistent relation to the presence of disturbances of the opticokinetic response. The case of a patient who had repeated convulsions, consisting simply of turning of the head and eyes and flexion of the arm on one side, was especially noteworthy, since the symptoms pointed to a circumscribed disturbance in the region of the frontal optomotor center and yet no deviation of the eyes with closure of the lids occurred between the convulsive seizures. Another

patient of the group had convulsions in which the eyes turned to one side and yet no deviation of the eyes on closure of the lids occurred between the attacks.

Noncerebral Lesions.—Observations were similarly made on patients with lesions of the cerebellum and the brain stem. The lesions, however, were less definitely limited to one side of the midline and the results were inconclusive. Of 6 patients who were presumed to have unilateral cerebellar lesions, 3 showed deviation of the eyes to the side of the lesion on closure of the lids, and 3 to the opposite side. Of 10 patients with presumed unilateral lesions of the brain stem, 4 showed deviation of the eyes to the side of the lesion on closure of the lids; 3, deviation to the opposite side, and 3, no deviation. With unilateral lesions of the labyrinth, the results were also inconclusive; 4 patients showed deviation to the side opposite the lesion; 2, deviation to the side of the lesion, and 2, no deviation. Of incidental interest is the observation that a significantly large number of patients (about 25 per cent) with congenital nystagmus of the jerking type, in which the visual acuity is relatively good but the opticokinetic response is defective, showed conjugate lateral deviation of the eyes on forced closure of the lids.

COMMENT

In general, the results confirm the observations of Prezzolini and Bárány in that unilateral cerebral lesions usually induce a conjugate deviation of the eyes to the side opposite the lesion when the lids are forcibly closed. However, no consistent deviation could be demonstrated with lesions of the cerebellum, brain stem or labyrinth.

The occurrence of the phenomenon does not depend on paralysis of conjugate gaze. It is often present in patients who show no paralysis of conjugate gaze (cerebral lesions) and may be absent in patients with gross limitation of conjugate gaze (lesions of the brain stem). Furthermore, the predominant direction of the deviation on closure of the lids (to the side opposite the lesion in cases of cerebral disease) is contrary to what one would expect if it were due to paralysis of conjugate gaze. The most likely explanation of this seeming paradox is to assume, as Bárány did, that, analogous to the condition in spastic hemiplegia, there is increased tonus on the side on which, under appropriate conditions, it is manifested as palsy, and that when the fixation reflex is abolished by closure of the lids the eyes deviate in the direction of greater tonus. This condition may be called spasticity of the conjugate oculomotor mechanism and, like its counterpart in the limbs, is postulated to be the result of supranuclear lesions in the central nervous system.

There is adequate theoretic support for such a concept, since the innervation of the ocular muscles is similar to that of other voluntary

muscles. Each half of the cerebrum represents the centers for conjugate gaze to the opposite side. The eyes are held in symmetric position only so long as the innervations from the two halves of the brain are equal, and any asymmetry in the tonus, such as occurs with a supranuclear lesion, would be expected to result in a conjugate deviation of the eyes. In the case of the eyes, this inequality in tonus becomes manifest as a deviation of the eyes when the fixation reflex is abolished by closure of the lids.

This spasticity of the conjugate mechanism to one side may account for the curious occurrence that with cerebral lesions the nystagmus may be greater to the side of the lesion than to the opposite side, as would be expected on a paralytic basis. It may also explain the reports of Guillain and Mollaret[4] and Klein and Stein,[5] in which patients with paralysis of voluntary conjugate gaze to one side were reported to have shown spontaneous turning of the eyes to the paralyzed side when the stimulus for fixation was removed.

Although the foregoing explanation applies to the majority of observations on the patients with cerebral lesions here reported, one cannot overlook the fact that there were exceptions. Some of these exceptions may have been due to limitations which were not, or could not be, controlled. The fallibility of symptomatic and operative localization has already been noted. There is also a personal source of error in making the initial records and transcriptions. Because of this discrepancy, deviation of the eyes with closure of the lids can have only correlative significance at present. When occurring with cerebral lesions, it suggests the side of the lesion but is not a wholly reliable sign.

SUMMARY AND CONCLUSIONS

Lateral conjugate deviation of the eyes with closure of the lids is relatively infrequent in persons with no known neurologic disease. Of the present series of 156 persons, it occurred in only 3.

With unilateral cerebral disease, a lateral conjugate deviation of the eyes with closure of the lids does occur in a significantly large percentage of patients, e. g., it was present in more than one-half the present series. The deviation is characteristically to the side opposite the lesion (that is, to the side of the hemiplegia and hemianopsia). It occurs with lesions in the anterior or the posterior part of the hemi-

4. Guillain, G., and Mollaret, P.: Etude clinique sur un phénomène non décrit dans la paralysie des mouvements de latéralité des yeux: la disparition de cette paralysie par l'occlusion palpébrale, Rev. neurol. **2**:74, 1931.

5. Klein, R., and Stein, R.: Ueber eigenartige Bewegungsautomatismen der Augen und ihren Einfluss auf Kopf und Körper bei einem Fall von fast totaler Blicklähmung, Zentralbl. f. d. ges. Neurol. u. Psychiat. **153**:242, 1935.

sphere. However, with presumably unilateral lesions of the cerebellum, brain stem or labyrinth, the deviation of the eyes with closure of the lids was not significantly more frequent to one side than to the other.

The predominant direction of deviation of the eyes on closure of the lids in cases of cerebral lesions is opposite that in which paralysis of conjugate gaze occurs and is assumed to be due to an increased tonus of the conjugate mechanism, analogous to spasticity of other muscles under voluntary control.

As a cognate sign of unilateral cerebral disease, deviation of the eyes on closure of the lids supplements, but does not replace, other signs. It may be present or absent when there is, or is not, gross paresis of conjugate gaze. Similarly, it may be present or absent with or without disturbances of the opticokinetic response, and with or without hemiplegic or hemianopic disturbances.

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CHEMOSURGICAL TREATMENT OF CANCER OF THE EYELID

A Microscopically Controlled Method of Excision

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SELECTIVE destruction of accessible forms of cancer is attained, in effect, with the microscopic control of excision afforded by the chemosurgical technic. The development of the chemosurgical method in the laboratory [1] and in the clinic [2] has been described, as has the use of the method in the treatment of cancer in specific sites, such as the lip,[3] nose [4] and ear.[5] The present article concerns the chemosurgical technic as applied to the treatment of cancer of the eyelid, and it presents the end results in 99 cases at the three year period and in 73 cases at the five year period.

TECHNIC

In the chemosurgical treatment of cancer of the eyelid, as in the treatment of cancer in other sites, the microscopic control is accomplished by means of a process consisting of the following steps: (1) in situ chemical fixation of the tissues suspected of being cancerous by means of a zinc chloride paste; (2) excision of a layer of the fixed tissue; (3) location of the cancerous areas by systematic microscopic examination of the excised tissues; (4) further chemical treatment of the areas demonstrated to be cancerous, and (5) repetition of the process until the cancer, including all its irregular extensions, has been entirely excised.

In order to illustrate the way in which the chemosurgical technic is used in the treatment of cancer of the eyelid, there will be described the chemosurgical excision of a cancer of the inner canthus (fig. 1 *A*). For two years the patient

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1. Mohs, F. E., and Guyer, M. F.: Pre-Excisional Fixation of Tissues in the Treatment of Cancer in Rats, Cancer Research **1**:49 (Jan.) 1941.

2. Mohs, F. E.: Chemosurgery: A Microscopically Controlled Method of Cancer Excision, Arch. Surg. **42**:279 (Feb.) 1941.

3. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Lip: A Microscopically Controlled Method of Excision, Arch. Surg. **48**:478 (June) 1944.

4. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Nose: A Microscopically Controlled Method, Arch. Surg. **53**:327 (Sept.) 1946.

5. Mohs, F. E.: Chemosurgical Treatment of Cancer of the Ear: A Microscopically Controlled Method of Excision, Surgery **21**:605 (May) 1947.

had been aware of a crusted ulcer near the inner canthus. The lesion was treated with radium on three occasions, the last being one year prior to his entrance to the chemosurgery clinic, but the growth had continued to spread.

The lesion, which measured 10 by 15 mm., consisted of an area of induration, in the center of which there was a crusted ulcer. The limits of the induration were indefinite, apparently because of the invasive nature of the neoplasm and because of the scarring from previous treatment.

After preparation with 0.03 Gm. of codeine sulfate and 0.65 Gm. of acetylsalicylic acid, the skin overlying the indurated area was given an application of dichloroacetic acid. This keratolytic chemical turned the skin white as it penetrated through the keratin layer; its function was to render the skin permeable to the fixative. The first application of the zinc chloride fixative[6] was made to a depth of 1 mm. The fixative was covered with a thin cotton dressing, which, in turn, was covered with an overlapping cotton dressing, spread with petrolatum to form a moisture-tight closure. Narrow strips of adhesive tape were accurately applied to hold the

Fig. 1.—*A*, basal cell carcinoma of group B (average diameter, 1 to 2 cm.). Starting at the inner canthus, the lesion had recurred after three radium treatments. *B*, lesion after chemosurgical excision of the cancer in four microscopically controlled stages (see fig. 2). The final layer of fixed tissue is adherent. *C*, granulation tissue after separation of the final layer of fixed tissue after seven days. *D*, healed lesion after four months.

dressing firmly in place. The analgesics previously mentioned were ordered to be given as often as every three hours, as needed.

On the next day a layer of fixed tissue 3 mm. thick was excised with a scalpel. There was no pain or bleeding from this operation because the incisions were made through killed and fixed tissue. A frozen section, cut vertically, revealed that the area was full of highly invasive basal cell carcinoma, although none could be distinguished by gross examination of the exposed surface, partly because of the

6. This fixative paste contains 40 Gm. of stibnite (80 mesh sieve), 10 Gm. of powdered sanguinaria N. F. and 34.5 cc. of a saturated solution of zinc chloride U. S. P.

scarring from the previous radium treatment and partly because the cancer grew as slender strands interspersed between the connective tissue fibers. The fixative was reapplied to the lesion to a depth of about 0.5 mm.

The next day a 2 mm. layer of fixed tissue was excised. Since gross inspection of the surface gave no indication of the presence of cancer, the entire area was subjected to microscopic examination. This was done by means of a process consisting of the following steps: (1) division of the excised layer into five specimens, the locations of which were mapped on the lesion (with merbromin N. F.) and on a pad of paper (fig. 2 *A*); (2) cutting of sections on the freezing microtome through the under surface of each specimen, and (3) examination of the specimens under the microscope and marking of the areas of cancer on the paper map with red pencil (stippled on the accompanying diagrams).

As shown on the diagram (fig. 2 *A*), there were three areas of cancer. Application of the fixative was limited to these areas.

On the next day another layer was excised from the areas. It was divided into nine specimens (fig. 2 *B*). Further treatment was limited to the one cancerous area, which was located in the cleft between the tarsal plate and the orbital part of the orbicularis oculi muscle. The next day no cancer was observed in the last area (fig. 2 *C*).

There remained a thin (1 to 2 mm.) layer of fixed tissue which was adherent to the underlying normal tissue (fig. 1 *B*). The lesion was covered with a

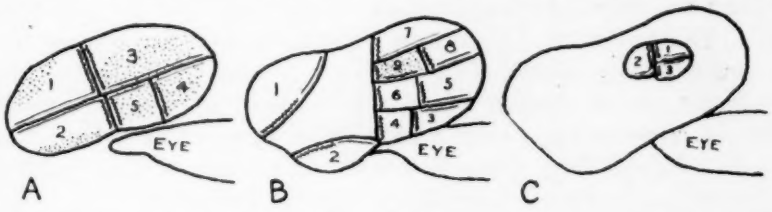

Fig. 2.—Maps showing the locations of specimens removed on the second, third and fourth days from the lesion pictured in figure 1. Microscopically located areas of cancer are stippled.

petrolatum gauze dressing. One week later the final layer of fixed tissue had separated except for a small area of exposed nasal bone in the center (fig. 1 *C*). (The average time for separation of fixed tissue from the eyelids is six days, with limits of two to eleven days; previous irradiation slows separation.) Since the bone was slow to separate, owing to the previous irradiation, no drastic attempt was made to remove it. Granulation tissue spread across the bone, and the lesion healed uneventfully, with a good cosmetic and functional result (fig. 1 *D*).

With careful chemosurgical technic, there is practically no danger of damaging the eyeball. The edema of the lids and the chemosis which result from the chemical inflammation tend to push the treated area away from the eyeball, and the tears dilute and carry away the fixative as it slowly permeates the eyelid.

The protective function of the tears is particularly evident in the treatment of cancer of the portion of the upper eyelid that overlies the cornea. In a number of cases the full thickness of the upper eyelid in this region was chemosurgically excised, and in no case was the eyeball damaged (figs. 11 and 14).

In 1 case, in which there was a large carcinoma of the middle of the upper lid, a hole 3 mm. in diameter resulted from its chemosurgical excision, so that the patient peered through the hole when his eye was closed (fig. 14). However, in spite of the action of the fixative on the lid directly over the cornea, there was no damage to the eye. Incidentally, the hole closed and the cosmetic result was practically perfect.

While the tears serve to protect the eyeball from damage by the fixative, they may also be a nuisance in that they may wet the dressings and carry the fixative away from the area under treatment. This difficulty is most likely to be encountered in the treatment of cancer at the lid margins, where the fixative may cause excessive tearing by making contact with the conjunctival surface. To obviate this difficulty, the fixative is applied to the skin only; if the conjunctiva is involved by the cancer, it is treated by approaching it from the cutaneous side of the eyelid. In some instances it is helpful to keep the eye closed under an eye patch.

Large portions of the eyelids may be removed without damage to the eyeball; but, of course, if the entire upper eyelid is removed, it is difficult to prevent the complications arising from exposure of the eyeball. The entire lower lid can be removed, however, without complications (fig. 7).

If the eyeball itself is extensively involved by the carcinoma, it must be removed (figs. 10 and 15). In 4 cases in this series surgical enucleation was done, either before or after chemosurgical treatment, while in 3 cases the eye was chemosurgically removed.

Chemosurgical removal of the eye also has been carried out during the chemosurgical excision of a number of extensive cancers which arose on the nose, forehead, temple or cheek. The operation is readily accomplished. For example, in the case of the patient shown in figure 15, the fixative was applied to the medial side of the eyeball, which had been deeply invaded by the cancer. On the following day the fixed sclera was removed and the vitreous humor evacuated. The fixative was then reapplied to the medial side of the eye and also to the interior of the eye. During the next four days the eye was removed by working from the medial side. The eyelids were partially preserved (fig. 15 *B* and *C*).

In some cases, it is desirable to cocainize the conjunctiva and quickly destroy the entire conjunctiva with dichloroacetic acid before proceeding with the chemosurgical removal of the eye. This is done because, while the eyeball itself is relatively insensitive, the conjunctiva is, of course, highly sensitive.

In a few earlier cases of this series, the scar contraction resulted in eversion of the eyelid with exposure and irritation of the palpebral conjunctiva (fig. 9 *C*). This complication may be avoided by the simple

expedient of removing the full thickness of the eyelid in cases in which the lid margin is appreciably involved. When this is done, the portion of the eyelid is pulled up into approximately normal position by the contraction of the scar (figs. 4, 6, 8 and 13).

When a large portion of the eyelid is removed, plastic repair may be desirable. Fortunately, the tissues are well vascularized and healthy after chemosurgical treatment; hence, they lend themselves well to such procedures.

Carcinomas which extend back of the orbital rim have a strong tendency to creep along close to the bony wall of the orbit. This phenomenon is most frequently seen with lesions involving the inner canthal region, but it is also fairly common in the floor of the orbit. By means of the chemosurgical technic these extensions often may be removed without damaging the eyeball. When the periosteum is involved, it is, of course, necessary to fix also a thin layer of bone; this fixed bone separates in about three weeks. If the cancer involves much of the floor of the orbit, the eyeball may drop a little after chemosurgical treatment, but, surprisingly, the extraocular motions are little impaired.

When the cancer extends much more than 2 cm. into the orbit, it may be necessary to remove the eye to obtain sufficient exposure. In several such instances the carcinoma was followed back to the inferior orbital fissure. If it extends through this fissure, further chemosurgical treatment is contraindicated.

THERAPEUTIC RESULTS IN CASES OF BASAL CELL CARCINOMA OF THE EYELID

A total of 80 basal cell carcinomas of the eyelid were chemosurgically excised during the six year period ending Oct. 28, 1943, which date is over three years prior to the time of this writing.

End Results After Three Years or More.—The 80 cases were divided into "indeterminate" and "determinate" groups according to the classification of Martin, MacComb and Blady.[7] The indeterminate group is composed of 18 cases in which the patients either died of other causes or were lost from observation without recurrence. The determinate group is composed of 62 cases in which there were obtained either unsuccessful results (4 cases) or successful results (58 cases).

In the 62 cases of the determinate group the rate of cure after three years or more was 93.5 per cent (table 1).

End Results After Five Years or More.—The end results for the five year period were evaluated for 60 consecutive cases, of which

7. Martin, H. E.; MacComb, W. S., and Blady, J. V.: Cancer of the Lip, Ann. Surg. **114**:341 (Sept.) 1941.

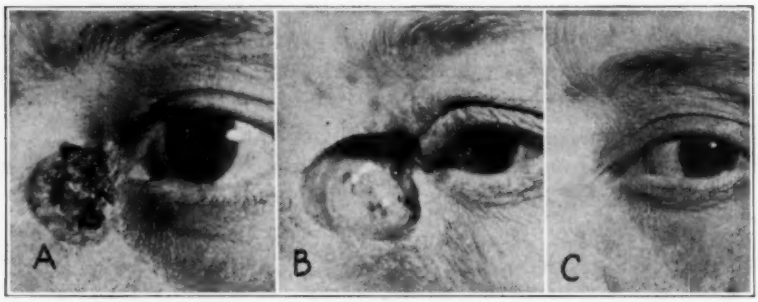

Fig. 3.—*A*, basal cell carcinoma of group C (average diameter, 2 to 3 cm.) in the inner canthal region. *B*, granulation tissue after the cancer had been removed in four microscopically controlled stages and after removal of the final layer of fixed tissue. *C*, healed lesion. The patient had been free of cancer for five years at the time of this report.

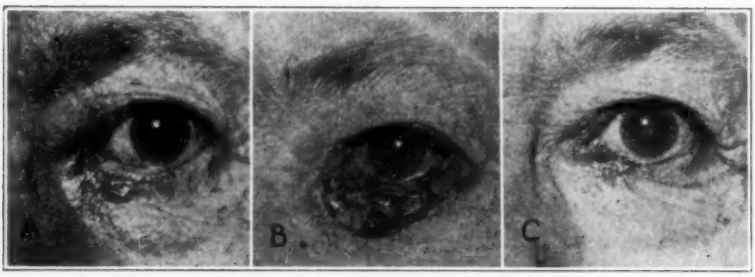

Fig. 4.—*A*, basal cell carcinoma of group A (average diameter, under 1 cm.) on the lower lid, near the inner canthus. It extended into the palpebral conjunctiva. *B*, granulation tissue after separation of the final layer of fixed tissue, showing the relatively large amount of tissue that had to be removed to eradicate the cancer, which had extended much farther than was clinically apparent. The full thickness of the lid at its margin was removed to avoid eversion. *C*, healed lesion. At the time of this report, four years later, there is no evidence of cancer.

Fig. 5.—*A*, basal cell carcinoma of group A, located several millimeters below the margin of the lid near the outer canthus. *B*, granulation tissue after separation of the final layer of fixed tissue. *C*, healed lesion. There was no evidence of cancer when the patient died, after three and one-half years.

13 were in the indeterminate group and 47 were in the determinate group. Of the latter group, there were successful results in 43 cases, and the rate of cure for the five year period was 91.5 per cent (table 1).

TABLE 1.—*End Results of Chemosurgical Treatment of Basal Cell Carcinoma of the Eyelids After Periods of Three Years and Five Years* *

	Three Year Period	Five Year Period
Total number of patients	80	60
Indeterminate group		
Patients who died of other causes without recurrence	11	8
Patients lost from observation without recurrence	7	5
Total number	18	13
Determinate group, total number	62	47
Unsuccessful results		
Patients dead, cancer present at time of death	2	2
Patients lost from observation, with cancer	2	2
Patients living, with cancer	..	..
Total number	4	4
Successful results		
Patients free from cancer for three years or more	58	
Patients free from cancer for five years or more		43
Three year end results		
Total number of patients with successful results divided by total number of patients in determinate group (58 ÷ 62)	93.5%	
Five year end results		
Total number of patients with successful results divided by total number of patients in determinate group (43 ÷ 47)		91.5%

* This series includes the cases of all patients with histologically proved basal cell carcinomas, both early and advanced, previously untreated and recurrent, who were admitted to the chemosurgical clinic during the period from Aug. 14, 1937 to Oct. 28, 1943, for the three year group, and during the period from Aug. 14, 1937 to Sept. 19, 1941, for the five year group.

TABLE 2.—*Relation of Size of Basal Cell Carcinoma to Prognosis*

Group	Average Diameter, Cm.	Number of Lesions	Successful Results	
			Number	Percentage
A	Under 1	31	31	100
B	1-2	22	21	95.5
C	2-3	5	4	80
D	3 or more	4	2	50
All groups		62	58	93.5

Effect of Size of Lesion on Prognosis.—The 62 cases in the determinate group in the three year period were divided into four groups according to the average diameter of the lesion: *A*, under 1 cm. (figs. 4, 5 and 11); *B*, 1 to 2 cm. (figs. 1, 6, 8 and 12); *C*, 2 to 3 cm. (figs. 3 and 7), and *D*, 3 cm. or more (figs. 9 and 10). It should be mentioned that the recorded sizes are those initially measured; the actual

size of the cancer, as determined by means of the microscopically controlled excisions, was often much larger.

As would be expected, the prognosis was, to some extent, influenced by the size of the lesion (table 2). However, extensiveness per se is not a contraindicatory factor for the chemosurgical treatment of basal cell carcinoma of the eyelid unless the neoplasm has extended into the cranial cavity. Other factors, such as old age, poor general health or uncooperativeness, were more influential than the size of the lesion in

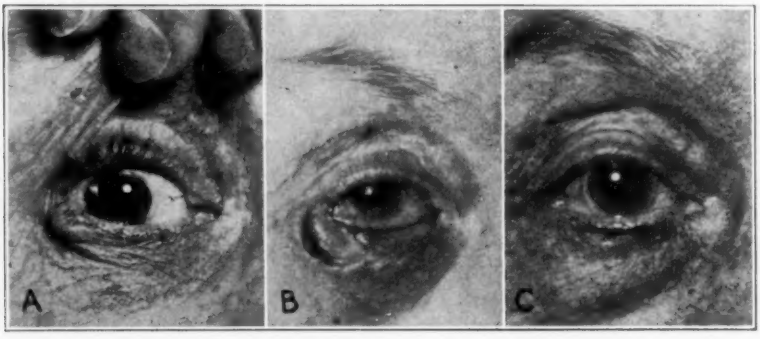

Fig. 6.—*A*, basal cell carcinoma of group B (average diameter, 1 to 2 cm.), located near the outer canthus. *B*, granulation tissue after chemosurgical excision of the cancer, which involved the full thickness of the lid. *C*, healed lesion. There was no evidence of cancer when the patient died, after two and one-half years.

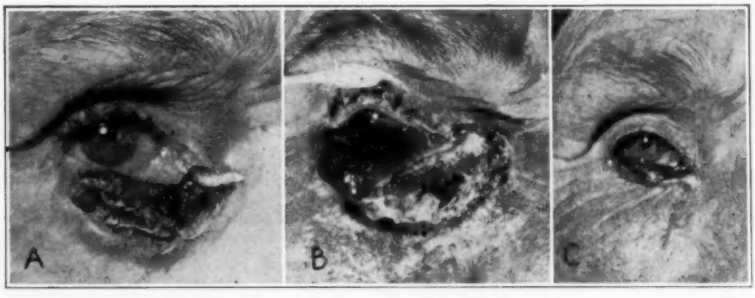

Fig. 7.—*A*, basal cell carcinoma of group C. It was of twenty years' duration and had recurred after roentgen ray treatment. *B*, granulation tissue laterally and adherent fixed tissue medially, in the inner canthal region, where the carcinoma had eroded deeply. *C*, healed lesion. There was no evidence of cancer when the patient died, after six years.

the decision to cease treatment before the cancer was eradicated in the 4 cases in this series in which treatment was unsuccessful.

Effect of Previous Unsuccessful Treatment on Prognosis.—Of the 62 cases in the determinate group in the three year period, there had been previous unsuccessful surgical treatment or irradiation in 20 cases

(32.3 per cent). The rate of cure for the group with previous treatment was only 85 per cent, as compared with 97.6 per cent for the group with no previous treatment (table 3).

However, the lower rate of cure for the group with previous treatment does not mean that previous treatment per se constitutes an unfavorable prognostic factor. It is more likely that the delay occasioned by the previous inadequate treatment, with consequent deep and exten-

Fig. 8.—*A*, basal cell carcinoma of group B. *B*, thin layer of adherent fixed tissue after four days, when a microscopically cancer-free plane had been reached. *C*, granulation tissue after the final layer of fixed tissue was removed, after five days more. *D*, healed lesion. The slight degree of ectropion could have been largely avoided if the full thickness of the lid margin had been removed. The patient is still free of cancer, after six years.

Fig. 9.—*A*, basal cell carcinoma of group D (average diameter, over 3 cm.), located on the lower lid in the outer canthal region. The cancer had continued to spread despite roentgen irradiation, electrodesiccation, cauterization with silver nitrate and radium treatments, over a period of seven years. *B*, granulation tissue after removal of the cancer in four microscopically controlled stages and after separation of the final layer of fixed tissue. *C*, healed lesion. The downward retraction of the lid could have been avoided by the removal of the full thickness of the lid margin, so that the upward pull of the scar in this region would counteract the downward pull of the scar inferior to the lid margin. There is no evidence of cancer, after five years. The ectropion does not bother the patient enough to cause him to return for the suggested repair.

sive spread of the cancer, has an unfavorable influence on prognosis. As a matter of fact, the most urgent indication for chemosurgical treatment is in the case in which other methods have failed.

Effect of Degree of Invasiveness on Prognosis.—To give some idea of the degree of malignancy, it is convenient to classify basal cell carcinomas as "invasive or "noninvasive." Microscopically, the invasive basal cell carcinoma exhibits slender, invasive strands of cancer cells which actively erode the normal tissues and produce a more or less

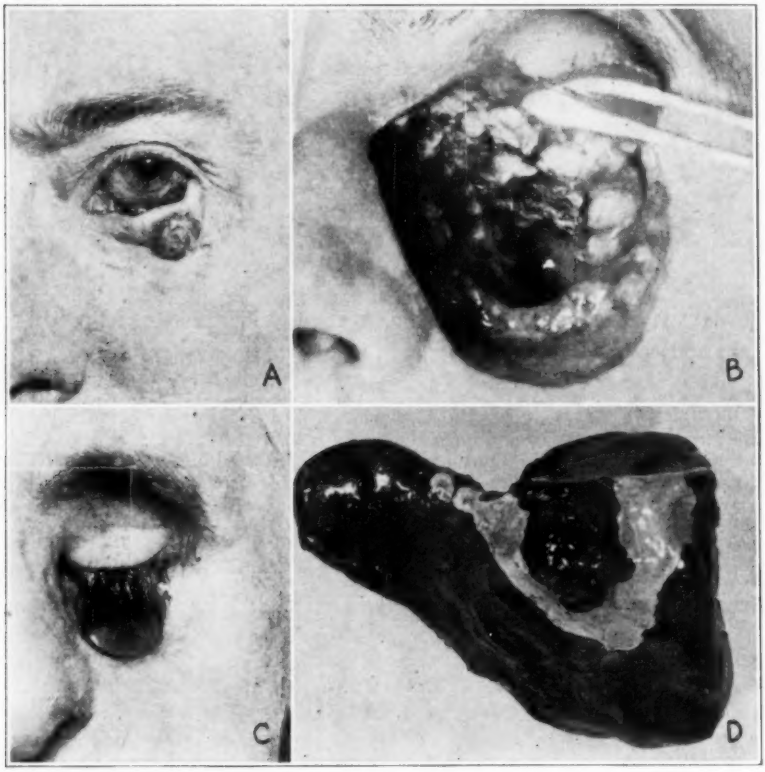

Fig. 10.—*A*, basal cell carcinoma of group D. The cancer, which was of fifteen years' duration, had been held in check superficially by means of fourteen radium treatments, over a period of seven years. *B*, granulation tissue after removal of the cancer, which involved the entire maxillary sinus, part of the nasal bone and so much of the tissue in the floor of the orbit that the eye had to be enucleated during the course of chemosurgical treatment. *C*, healed lesion, showing antrum lined with mucosa. The patient is still free of cancer, after eight years. *D*, reconstruction of the cancerous mass, showing clinically visible portion (central dark area) and palpable portion (light area). The extensions into the orbit, onto the nasal bone and into the maxillary sinus are also shown.

copious reaction of the connective tissue stroma. On the other hand, the noninvasive carcinoma is composed of clumps of cancer cells which are well demarcated from the normal tissues, which as a rule contribute

little connective tissue stroma. There are numerous intergradations, so that it is sometimes difficult to decide in which group a given lesion belongs.

Clinically, the "invasive" carcinoma is apt to be the ingrowing, rodent ulcer type of lesion, while the "noninvasive" carcinoma is usually the outgrowing, nodular type.

TABLE 3.—*Effect of Previous Unsuccessful Treatment of Basal Cell Carcinoma on Prognosis*

	Number of Patients	Successful Results	
		Number	Percentage
Previously treated	20	17	85
Previously untreated	42	41	97.6

TABLE 4.—*Effect of Histologic Degree of Invasiveness of Basal Cell Carcinoma on Prognosis*

	Number of Lesions	Successful Results	
		Number	Percentage
Invasive	29	25	86.2
Noninvasive	33	33	100

TABLE 5.—*Effect of Site of Origin of Basal Cell Carcinoma on Prognosis*

Site	Number of Lesions	Successful Results	
		Number	Percentage
Upper eyelid	17	16	94.1
Lower eyelid	29	29	100
Inner canthus	10	8	80
Outer canthus	6	5	83.3

That the noninvasive cancers are less dangerous than the invasive lesions is attested by the fact that 100 per cent of the former were cured, whereas 86.2 per cent of the invasive cancers were eradicated (table 4). However, it is in the treatment of the highly invasive lesions that the chemosurgical technic is of particular value, because it provides a means of following out the deep-seated, often unsuspected outgrowths characteristic of this type.

Effect of Site of Origin on Prognosis.—The most frequent site of origin of basal cell carcinoma was the lower eyelid, and 100 per cent of the cancers in this location were cured (table 5). The next most frequent site was the upper eyelid, and a high proportion of these lesions were also cured (94.1 per cent). However, the uncommoner cancers

which originated in the canthal regions carried a somewhat less favorable prognosis (outer canthus, 83.3 per cent; inner canthus, 80 per cent). These findings are consistent with the notoriously invasive nature of basal cell carcinoma in these locations, particularly in the inner canthus. However, the prognosis in the canthal lesions is appreciably improved by the use of the chemosurgical method, with its microscopic control of excision.

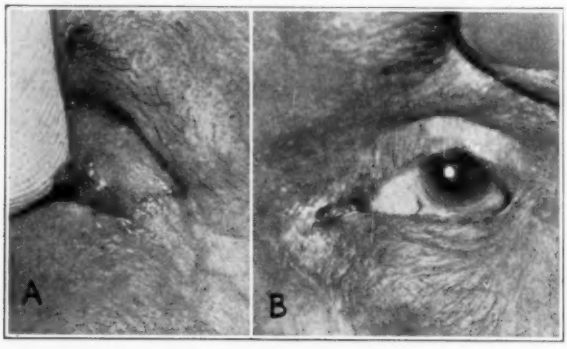

Fig. 11.—*A*, basal cell carcinoma, group A. The cancer involved the full thickness of the portion of the upper lid overlying the cornea. *B*, healed lesion. There was no evidence of cancer when the patient died, after five years.

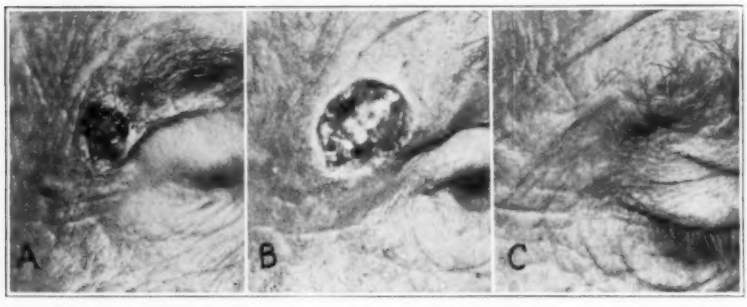

Fig. 12.—*A*, basal cell carcinoma of group B, located on the upper lid and the adjacent brow. *B*, granulation tissue after separation of the final layer of fixed tissue. *C*, healed lesion. The patient is free of cancer, after five years.

THERAPEUTIC RESULTS IN CASES OF SQUAMOUS CELL CARCINOMA OF THE EYELID

Squamous cell carcinoma being a relatively uncommon lesion of the eyelids, only 19 were chemosurgically treated during the six year period from May 12, 1937 to April 19, 1943, the latter date being over three years prior to this writing. The primary lesion in every case was successfully treated, but in 1 case fatal metastasis developed.

End Results After Three Years or More.—The end results after an observation period of three years or more were evaluated for the 19 consecutive cases in this group. There were 3 cases in the indeterminate category, leaving 16 cases in the determinate group. In the latter group there were 15 cases in which the treatment was successful and 1 in which it was unsuccessful. Thus, the rate of cure for the three year period was 93.8 per cent (table 6).

End Results After Five Years or More.—There were 13 cases in the group in the five year period, and of these, 11 were in the determinate group. There was 1 case in the latter group in which treatment was unsuccessful. Thus, the rate of cure for the five year period was 90.9 per cent (table 6).

Factors Which Influence the Prognosis.—Among the factors which would be expected to influence the prognosis in cases of squamous cell carcinoma of the eyelid are size of lesion, previous treatment, histologic

Fig. 13.—*A*, squamous cell carcinoma of group B, of grade 1 malignancy (Broders' classification). *B*, granulation tissue after separation of the final layer of fixed tissue. *C*, healed lesion.

grade of malignancy, site of origin and presence or absence of metastasis. Since the series is small and there was only 1 case in which treatment was unsuccessful, the data are insufficient to justify tabulation of the results as affected by these factors.

The distribution of the cases as regards the size of the lesion was as follows: group A (average diameter, under 1 cm.), 9 cases; group B (1 to 2 cm.), 4 cases; group C (2 to 3 cm.), 2 cases, and group D (3 cm. or more), 1 case. The case in which treatment was unsuccessful was in group B, and the conclusion is that size per se was not an important factor in this series. However, if the lesion were so extensive that vital structures, such as the brain, were involved, the prognosis would, of course, be affected.

Previous unsuccessful therapy would be expected to affect prognosis in that it might cause a delay in chemosurgical treatment, with conse-

quent increase in extensiveness and increase in likelihood of metastasis. In this series only 1 patient had received previous treatment. The patient who died of cancer had not had previous treatment.

The carcinomas in the 16 cases of the determinate group in the three year period were classified according to Broders' four grades of malignancy, as follows: grade 1, 11 lesions; grade 2, 3 lesions; grade 3, 1 lesion, and grade 4, no lesions. In the 1 case in which treatment failed the carcinoma was of grade 3 malignancy. The poorer prognosis occasioned by higher degrees of malignancy is largely due to the increased likelihood of metastasis.

TABLE 6.—*End Results for Squamous Cell Carcinoma of the Eyelids After Periods of Three Years and Five Years* *

	Three Year Period		Five Year Period	
Total number of patients		19		13
Indeterminate group				
Patients who died of other causes without recurrence	2		1	
Patients lost from observation without recurrence	1		1	
Total number		3		2
Determinate group, total number		16		11
Unsuccessful results				
Patients dead, cancer present at time of death	0		0	
Patients lost from observation, with cancer	1		1	
Patients living, with cancer	0		0	
Total number		1		1
Successful results				
Patients free from cancer for three years or more		15		
Patients free from cancer for five years or more				10
Three year end results				
Total number of patients with successful results divided by total number of patients in determinate group (15 ÷ 16)		93.8%		
Five year end results				
Total number of patients with successful results divided by total number of patients in determinate group (10 ÷ 11)				90.9%

* This series includes the cases of all patients with histologically proved squamous cell carcinoma, both early and advanced, previously untreated and recurrent, who were admitted to the chemosurgical clinic during the period from May 12, 1937 to April 10, 1943, for the three year group, and during the period from May 12, 1937 to Jan. 19, 1943, for the five year group.

Of the 16 cases of squamous cell carcinomas in the determinate series, the lesion originated on the lower eyelid in 12 cases and on the upper eyelid in 4 cases. In none did it arise in the canthal regions. In the 1 case in which treatment was unsuccessful the carcinoma arose on the lower lid, but no definite conclusions can be drawn as to the effect of the site of origin on prognosis.

Metastasis was the complication responsible for the unsuccessful result in 1 case. The lesion, which had a malignancy of grade 3, was located on the lower eyelid at the junction with the cheek. This primary

lesion did not recur after chemosurgical treatment, but on a check-up visit two years later, a large, fixed submaxillary mass was found. This had appeared while the patient supposedly was being kept under observation by the family physician. Presumably, this mass was a metastatic lesion, although it was impossible to rule out the possibility of its having originated as a primary lesion of the submaxillary salivary gland, which

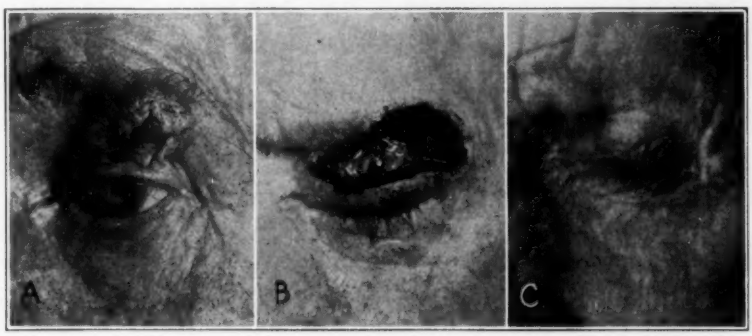

Fig. 14.—*A*, squamous cell carcinoma of group B, of grade 2 malignancy. *B*, granulation tissue and hole through the full thickness of the eyelid directly over the pupil after separation of the final layer of fixed tissue. *C*, healed lesion. The hole closed spontaneously within one month. The patient is free of cancer, after five years.

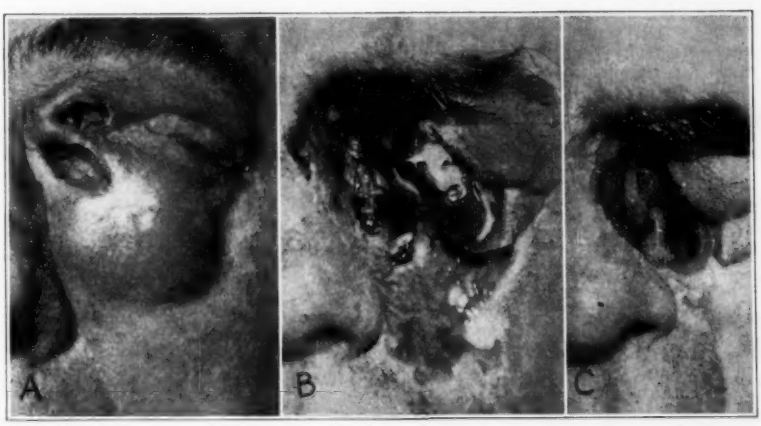

Fig. 15.—*A*, squamous cell carcinoma of group D. The degree of malignancy was grade 3. *B*, granulation tissue after separation of the final layer of fixed tissue, following removal of the cancer in eighteen microscopically controlled stages. The medial rectus muscle and the medial portion of the sclera were eroded through by the cancer, so that the eyeball was chemosurgically removed. The cancer also had eroded through the nasal bone into the nasal mucosa and through the maxillary bone into the antrum. *C*, healed lesion. The defect was closed with a graft after a year, and there is no evidence of cancer, after five years.

it involved. The mass was radically excised by means of the chemosurgical technic, but the growth recurred, and the patient presumably

died of cancer. There was no recurrence of the primary lesion when the patient was last seen, three and one-half years after chemosurgical excision. This case emphasizes the importance of insisting on particularly close observation of patients with squamous cell carcinoma.

The question of the desirability of prophylactic dissection of regional lymph nodes may occasionally arise. It would seem that a fairly large lesion with a grade of malignancy of high 2 or higher should lead one to consider the advisability of a prophylactic dissection.

THERAPEUTIC RESULTS FOR OTHER LESIONS OF THE EYELIDS

The microscopic control of excision afforded by the chemosurgical method is also of value in the removal of other neoplasms and of precancerous lesions affecting the eyelids. The following lesions were successfully treated: hemangioma, pigmented nevus, radiation ulcer, seborrheic keratosis and senile keratosis (7 cases).

In 5 cases the senile keratosis had become papillated, and no doubt were undergoing malignant change in some cases. It is in the treatment of these lesions in which it is difficult to determine grossly whether or not cancer is present that the microscopic control of the chemosurgical technic is particularly valuable.

COMMENT

In the course of the treatment of the 99 carcinomas reported on here, it became evident that cancers of the eyelid, particularly those in the inner canthal region, are often unpredictable in the direction and extent of their invasion into the normal tissues. Frequently, small caliber, grossly undetectable extensions from the main cancerous mass occur; and it is only by means of the microscopic control afforded by the chemosurgical technic that these outgrowths can reliably be removed without excessive destruction of normal tissue.

That the method is uncommonly reliable is indicated by comparison with the best series in the literature, as regards both excellence of results and adequate statistical analysis, namely, that of Magnusson.[8] The results reported by this author were obtained with the use of the highly developed radiologic, surgical and electrosurgical technics used at *Radiumhemmet* in Stockholm. From his protocols, it was determined that the rate of cure for the three year period for all types of cancer of the eyelid was 89.5 per cent. In the present series, the rate of cure for the same interval was 93.6 per cent. Both series were practically identical as regards the per cent of cases in the two larger

8. Magnusson, A. H. W.; Skin Cancer: A Clinical Study with Special Reference to Radium Treatment, Acta radiol., 1935, supp. 22, p. 1.

groups (15 per cent) and as regards the per cent of the lesions which were recurrent after previous treatment (27 per cent).

This reliability of the chemosurgical method is not attained by excessively radical excision. Quite the contrary, no more than 1 or 2 mm. of tissue beyond the points of cancerous involvement is removed. When undesirable defects do occur, owing to extensive carcinomatous invasion, they are relatively readily repaired because the remaining tissues are well vascularized and healthy. Moreover, since a maximum amount of normal tissue is preserved there is more tissue to work with in making a repair.

The safety of the eyeball during the course of chemosurgical treatment of cancer of the eyelids is an important advantage. In this series, no bulbar damage occurred except with those lesions which actually invaded the eyeball. The protective effect of the edema of the lid, the chemosis and the flow of tears is responsible for this safety.

Chemosurgical treatment entails practically no mortality. In this series there were no deaths during treatment despite the fact that many of the patients were old and in poor general health.

Some lesions of the eyelid are technically difficult to excise chemosurgically, and experience with the method is advisable before the treatment of these lesions is undertaken.

SUMMARY AND CONCLUSIONS

The chief advantage of the chemosurgical treatment of cancer of the eyelid is the microscopic control of excision afforded by the method. This control is responsible for both the great reliability and the conservatism of the method.

The reliability of the method is attested by the high rates of cure. Thus, for basal cell carcinoma, successful results were attained in 93.5 per cent of the 62 cases in the three year period and in 91.5 per cent of the 47 cases in the five year period. For squamous cell carcinoma, the rate of cure was 93.8 per cent for the 16 cases in the three year period and 90.9 per cent for the 11 cases in the five year period.

The reliability of the method is not attained at the expense of conservatism, for only 1 or 2 mm. of tissue beyond the points of carcinomatous invasion is removed.

The method is also effective in the removal of various benign neoplasms and precancerous lesions of the eyelids.

State of Wisconsin General Hospital.

ANIRIDIA CONGENITA

Report of Five Cases; Genealogy; Possibilities of Treatment

MORRIS H. PINCUS, M.D.
BROOKLYN

AT THE Industrial Home for the Blind, Brooklyn, I examined 5 patients with bilateral aniridia. Inasmuch as this is a rare congenital condition,[1] it was believed that a report of these cases, including the genealogy and the possibilities of treatment, would be of interest.

REPORT OF CASES

CASE 1.—J. K. Sr., aged 57, of Irish descent, had had poor vision since birth. Except for a mild degree of diabetes, which was controlled by diet, he was in good health.

His forehead was furrowed. Bilateral ptosis was present. A circumcorneal fringe of superficial blood vessels penetrated the cornea of each eye, but the pupillary portions were clear. The anterior chambers were deep in appearance. No iris was visible in either eye with reflected light, but with the slit lamp a very small tag of iris tissue was just barely seen at the superior temporal angle of both the right and the left eye. The zonule was not visible. Each lens revealed anterior cortical, as well as dense nuclear, changes. A fundus glow (reflex) was present in the right eye, but no details were discernible. There was no fundus glow in the left eye. The ocular movements of each eye were normal, even though an esotropia of approximately 25 degrees was present in the left eye. Ocular tension (McLean) was 23 mm. of mercury in the right eye and 23 mm. in the left eye.

Vision was 5/200 in the right eye and was limited to perception of hand movements at 1 foot (30 cm.) in the left eye.

There was no improvement in vision in either eye with lenses.

CASE 2.—The patient's son, J. K. Jr., aged 23, was a robust, physically normal man; he had had poor vision since birth (fig. 1).

His forehead was furrowed. The palpebral fissures were narrow, owing to slight ptosis. A fine horizontal and a coarse rotary nystagmus were present. The corneas were clear. The anterior chambers were deep. No iris tissue was visible in either eye by reflected light or with the slit lamp. A number of small opacities were scattered throughout the anterior and the posterior cortex of each lens. Owing to the nystagmus, details of the fundus were not distinct, but each disk appeared pale, the blood vessels attenuated and the macular area dull (no

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Read before the Brooklyn Ophthalmological Society, Dec. 19, 1946.

From the Department of Ophthalmology, Long Island College Hospital and College of Medicine; John N. Evans, M.D., ophthalmologist in chief.

1. Duke-Elder, W. S.: Text-Book of Ophthalmology, London, Henry Kimpton, 1938, vol. 2, pp. 1298-1302.

reflex). The ocular movements revealed the presence of double hypertropia. Ocular tension (McLean) was 38 mm. of mercury in the right eye and 40 mm. in the left eye.

Vision was 14/200 in the right eye and 11/200 in the left eye.

CASE 3.—Mr. E. H., aged 24, of Jewish descent, apparently in good health, (fig. 2), was born with bilateral ptosis and poor vision.

His brow was furrowed. Bilateral ptosis, more conspicuous on the left side, was present. A fine horizontal nystagmus existed. Both corneas were clear. The anterior chambers were deep, and no iris tissue was visible in either eye by reflected light or with the slit lamp. Each lens revealed symmetrically placed, coralliform opacities in the posterior cortex, but the central area was clear. The margins of the lens were distinctly seen, and the zonule appeared normal. In spite of the nystagmus, a fairly good view of each fundus was possible. The disk in each eye was very small and appeared pale. The blood vessels were attenuated

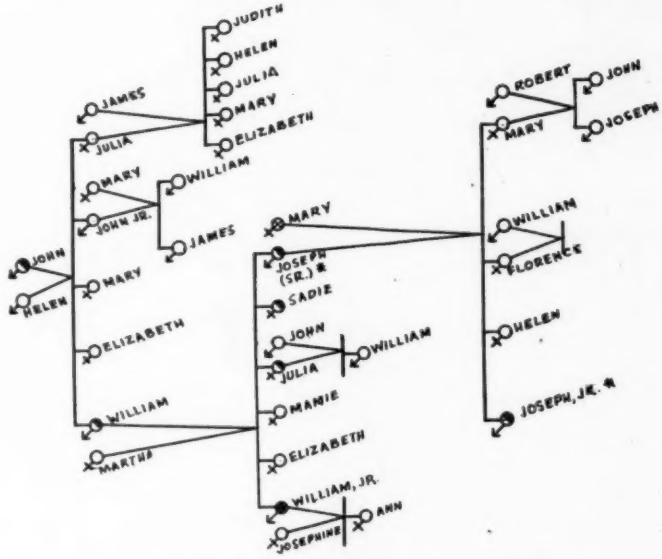

Fig. 1.—Genealogic chart of the J. K. family (case 2).

In this chart, and in the accompanying charts, normal eyes are indicated by clear circles; the presence of aniridia is shown by half black circles; blindness of one eye, due to a fall, by a black circle; blindness of one eye, of unknown cause, by a circle with cross, and blindness of both eyes, cause unknown, by a circle with question mark. The asterisk indicates that the case was presented in the text.

and the maculas dull. No other abnormalities were noted. Ocular movements were normal. Ocular tension (McLean) was 35 mm. of mercury in the right eye and 40 mm. in the left eye.

Vision was 16/200 in the right eye and 15/200 in the left eye.

CASE 4.—J. M. Q., aged 42, a well built, healthy white man, of Irish descent, had had poor vision since birth (fig. 3). The palpebral fissures were narrow. A fine horizontal nystagmus was present. Each cornea had a number of nebulous opacities, with the blood vessels from the inferior limbus infiltrating the stroma. The anterior chambers appeared deep, and no iris tissue was visible in either eye by reflected light or with the slit lamp. Each lens was visible in its entirety

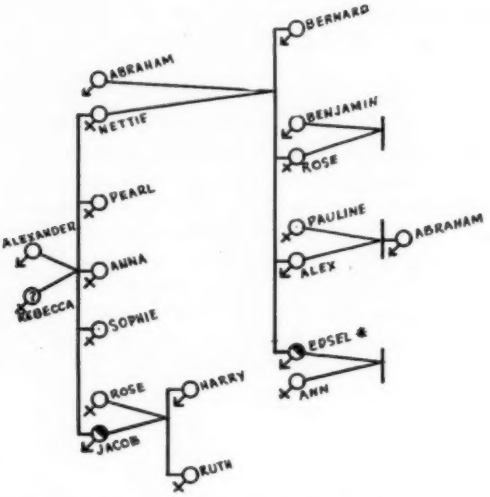

Fig. 2.—Genealogic chart of E. H. family (case 3).

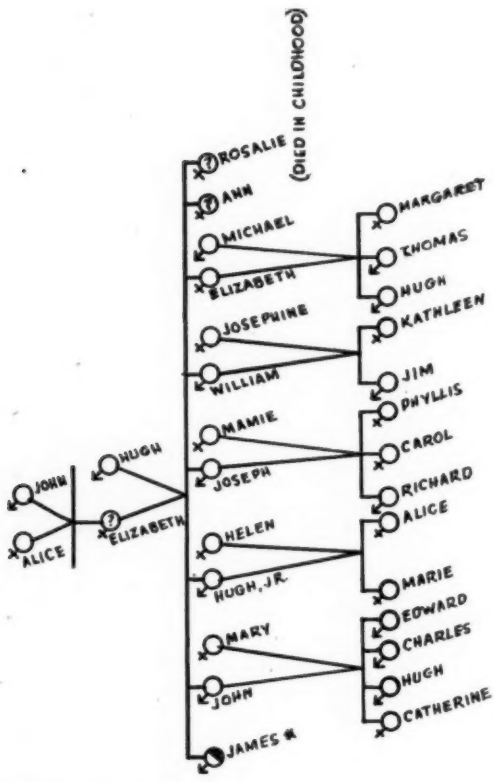

Fig. 3.—Genealogic chart of J. M. Q. family (case 4).

It was yellowish, and the nuclear and posterior cortical regions were rather opaque. There was a dull fundus glow in each eye, but no details were visible. Ocular movements were normal. Ocular tension (McLean) was 30 mm. of mercury in the right eye and 30 mm. in the left eye.

Vision was 3/200 in the right eye; light perception with good projection was present in the left eye.

There was no improvement in either eye with lenses.

CASE 5.—G. C., aged 27, of Italian descent, had always had poor vision (fig. 4).

He had slight ptosis of both upper lids, moderate frontal furrowing and pronounced horizontal and rotary nystagmus. The periphery of both corneas was invaded with fine blood vessels. The anterior chambers were deep and no iris tissue was visible in either eye on superficial examination, but with the slit lamp a small stump of iris was seen in the lower temporal angle of each eye. Brownish pigmented particles were visible on the anterior surface of the lens capsule. A few anterior and posterior cortical opacities were present. Owing

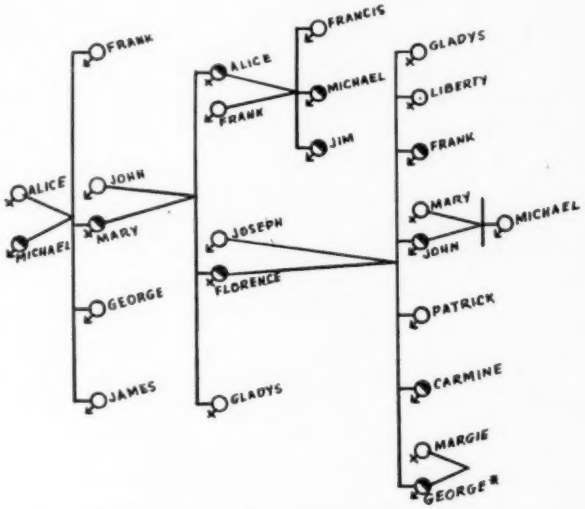

Fig. 4.—Genealogic chart of G. C. family (case 5).

to the nystagmus, details of the fundus could not be visualized. Ocular movements were normal. Ocular tension (McLean) was 30 mm. of mercury in the right eye and 30 mm. in the left eye.

Vision was 11/200 in the right eye, improved to 15/200 with a correction of -4.00 sph. $\frown$ -0.50 cyl., axis 30 and 11/200 in the left eye, improved to 15/200 with a correction of -2.00 sph. $\frown$ -0.75 cyl., axis 180.

COMMENT

The clinical picture of aniridia is characteristic. The most obvious features of the condition are the furrowing of the brow, the narrowing of the palpebral fissures, the photophobia and the appearance of an unusually large pupil, generally associated with very poor vision and frequently accompanied with nystagmus.

The low visual acuity has been accounted for by the fact that on a number of clinical examinations the fovea was observed to be absent.[2] This absence was confirmed histologically.[3] Alger,[4] however, expressed the opinion that the poor vision is due to the aberration of the light rays entering the eye in the regions both outside and inside the equator of the lens. He stated:

> . . . it [the fovea centralis] does not develop fully until 16 weeks after birth. Just what causes it to develop after birth is not known, but it is probably due to the light striking it and stimulating it. . . . In the case of aniridia . . . , the light is not concentrated at the macula in a clear pattern of an image and the stimulation of the macula does not take place as it would in ordinary eyes. Consequently, the macula would not have a tendency to form in the normal fashion.[4]

Glaucoma as a secondary complication is not uncommon.[5] The association, however, is not invariable. Dennis [6] noted that physostigmine almost invariably controls the increased ocular tension accompanying aniridia. He suggested that the tension is probably lowered by reason of the well known power of this drug to contract blood vessels.

In all reported histopathologic examinations [7] of aniridic eyes, a small rim of iris tissue of variable degree is observed encircling the periphery. The iris tissue is rudimentary, and the musculature is absent or very poorly developed. The pigment epithelium may be plicated at the free border and may overlap the stump of the iris as an ectropion. The trabeculae at the root of the iris are frequently anomalous, and the iris may be adherent to the cornea, so that the angle of the anterior chamber is obliterated. Although the obliteration of the angle is not invariable, it may account for the complication of glaucoma. The ciliary processes may be normal, but they are frequently small, aplastic or absent. The lens may be ectopic, cataractous or small. Persistent vessels of the vascular tunic of the lens have been noted. The retina may

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2. Vogt, A.: Ueber angeborenes und vererbtes Fehlen der Macula lutea, Klin. Monatsbl. f. Augenh. **72**:806, 1924. Duke-Elder.[1]

3. (*a*) Seefelder, R.: Die Aniridie als eine Entwicklungshemmung der Retina, Arch. f. Ophth. **70**:65, 1909. (*b*) Holm, E.: Ein anatomisch untersuchter Fall von Aniridie, Klin. Monatsbl. f. Augenh. **66**:730, 1921.

4. Alger, L. G.: Cause and Treatment of Poor Vision in Aniridia, Am. J. Ophth. **28**:730, 1945.

5. (*a*) Collins, E. T.: Aniridia and Glaucoma, Ophth. Rev. **10**:101, 1891. (*b*) Neher, E. M.: Aniridia Congenita, Irideremia: Report of Cases Extending Through Five Generations, Am. J. Ophth. **21**:293, 1938. (*c*) Hudson, A. C.: Congenital Aniridia Treated by Sclero-Corneal Trephining, Tr. Ophth. Soc. U. Kingdom **41**:274, 1921.

6. Dennis, D. N.: Double Congenital Aniridia with Glaucoma and Cataract: Extraction with Resulting Good Vision; Observations on the Action of Eserin Where the Iris Is Absent, Arch. Ophth. **35**:527, 1906.

7. Collins, E. T., and Mayou, M. S.: Pathology and Bacteriology of the Eye, in Pyle, W. L.: An International System of Ophthalmic Practice, Philadelphia, P. Blakiston's Son & Co., 1911, pp. 75-79. Duke-Elder.[1] Footnote 3.

show abnormalities, such as degeneration in the periphery, changes in the ganglion cells and absence of the fovea centralis.

The hereditary tendency of aniridia is pronounced, the anomaly behaving as a dominant characteristic.[8] Figures 1 to 4 corroborate this observation. The anomaly is not sex linked. There is no racial or national predilection.

Many theories have been advanced to explain the occurrence of aniridia.[1] The preponderance of evidence substantiates the congenital nature of the condition,[9] the mechanism reducing itself to failure in development of the retinal ectoderm or to aberrant development of the vascular mesoderm.[1] Possibly both factors are operative in different cases. Neher [5b] stated:

> . . . Cognizance is taken of the fact that mesodermic tissue passes forward normally around the equator of the lens to join the anterior mesodermal ingrowth, not only in the region of the fetal cleft, but in all directions. Its presence is normal, and it gives way to the iris as the latter grows in from all sides, offering no resistance except where the mesoderm is hyperdeveloped or possibly overvascularized. Should only a strand of tissue be thus affected, a coloboma is formed. If the whole tissue is hyperresistant, the iris cannot grow as it normally does and aniridia results.

As has already been mentioned, poor vision is one of the prominent features of this condition. Although nothing can be done to correct the aniridia, several useful procedures are available to help unfortunate persons with this defect to obtain and to maintain useful vision. Alger [4] tattooed the periphery of the corneas of a 20 month old child with typical aniridia, and two years later reexamination revealed 20/20 vision in the left eye and somewhat less in the right eye.

Dennis,[6] Blue [10] and Bieringer [11] obtained useful vision after the extraction of a cataractous lens.

Reid [12] obtained 6/6 vision in an adult with typical congenital aniridia by the use of contact glasses containing an opaque brown corneal portion with a 2.5 mm. clear central pupil. These glasses were worn comfortably for twelve hours a day.

Hudson [5c] reported the case of a 7 week old child, with bilateral aniridia, who had edema of the cornea, a dull fundus reflex and

8. Wood, C. A.: The American Encyclopedia of Ophthalmology, Chicago, Cleveland Press, 1913, vol. 1, p. 483. Croll, L. J.: Aniridia Occurring in Three Generations, Arch. Ophth. **2**:699 (Dec.) 1929. Risley, S. D.: Hereditary

9. Mann, I.: Coloboma Iridis and Its Embryology, Tr. Ophth. Soc. U. Aniridia: An Interesting Family History, J. A. M. A. **64**:1310 (April 17) 1915. Duke-Elder.[1] Alger.[4] Neher.[5b]
Kingdom **44**:161, 1924. Seefelder.[3a] Neher.[5b] Collins and Mayou.[7]

10. Blue, J. B.: Bilateral Aniridia, Am. J. Ophth. **5**:483, 1922.

11. Bieringer, S.: Linsenextraktion bei Aniridie, Klin. Monatsbl. f. Augenh. **88**:744, 1932.

12. Reid, A. M.: Case of Congenital Aniridia Fitted with Pigmented Contact Glasses, Tr. Ophth. Soc. U. Kingdom (pt. 1) **58**:434, 1938.

increased intraocular pressure in the right eye. A paracentesis was performed, and the cornea cleared almost immediately. One week later a corneoscleral trephination was performed. The intraocular tension became satisfactory, and the fundus reflex returned to normal brightness.

With these tried methods of treatment at hand, I felt that improvement in the visual acuities of patients 1 and 4, who have mature cataracts, would best be accomplished by extracting the lenses. To date, however, these patients have postponed surgical intervention.

The right eyes in cases 2, 3 and 5 were tested with a trial contact lens which possessed an opaque corneal periphery and a 4 mm. clear central pupil. The results are as follows:

Case 2: Vision (O. D.): 14/200, improved to 20/200 with the trial contact lens and —1.00 D. sph.

Case 3: Vision (O. D.): 16/200, improved to 20/200 with the trial contact lens and —3.00 D. sph.

Case 5: Vision (O. D.): 11/200, improved to 20/200 with the trial contact lens and —2.00 D. sph.

The improvement of vision in each of these cases would tend to support the theory that aberration of light entering the eye is responsible in great measure for the poor visual acuity in aniridia.

SUMMARY

Five cases of bilateral aniridia, with the genealogic charts and a discussion of the possibilities of treatment, are presented. Aniridia is an uncommon congenital anomaly, is almost always bilateral and appears as a dominant characteristic. It is not sex linked, nor is there a national or racial predilection.

The clinical and pathologic features are a furrowed brow, narrow palpebral fissures, unusually large pupils, photophobia, poor vision and, frequently, nystagmus. Pathologically, a small rim of iris tissue, of variable degree, is always observed encircling the periphery. The apparent absence of the iris on clinical examination is due to the fact that a short stump is hidden behind the corneoscleral margin. Other ocular defects, such as ptosis, muscular imbalance, corneal disturbances, lenticular anomalies and retinal pathologic changes are common. Glaucoma, as a secondary complication, is not uncommon.

Several useful procedures are available to help unfortunate persons with this defect to obtain and to maintain useful vision. In order to be effective, treatment should be started early in life. Tattooing of the outer portions of the cornea, extraction of a cataractous lens and the wearing of an opaque contact lens with a 3 to 4 mm., clear central pupil are the methods of choice. Glaucoma, as a secondary complication, can be controlled with physostigmine or by corneoscleral trephining.

881 Washington Avenue.

HUMAN CONJUNCTIVA GRAFTED ON THE CHORIO-ALLANTOIS OF CHICK EMBRYOS

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AND
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IN THIS study we report an attempt to graft human conjunctiva on the chorioallantois of chick embryos according to the method developed by Goodpasture and associates for the human skin.[1]

TECHNIC

The conjunctival sac was anesthetized by instillation of 1 drop of a 4 per cent solution of cocaine hydrochloride. An oval piece of conjunctiva, 7 to 8 mm. long and about 2 to 3 mm. wide, was excised with scissors from the lower fornix and transferred into 2 cc. isotonic solution of sodium chloride containing 50 Oxford units of penicillin per cubic centimeter. The fragments of conjunctiva suspended in this solution were placed in a refrigerator for four to six hours.

Fertile hens' eggs kept in an incubator for eight to eleven days were used in the grafting experiments. The eggs were candled, and the places corresponding with the air bubble and the large membrane vessels were marked on the shell. The egg was placed on a stand of plasticine, the shell cleansed with alcohol, and a window of 1 cm. square cut with a rotating carborundum disk, according to the method of Goodpasture and Buddingh.[2] The shell was perforated at the location of the air bubble with a sterile needle and the air aspirated with a small rubber balloon. In this way, the fibrous membrane was separated from the adherent chorioallantoic membrane of the shell, making it possible to cut the fibrous membrane without injuring the chorioallantois in the majority of cases.

For the purpose of grafting, a piece of conjunctiva 2 to 3 mm. square was spread on the blade of a cataract knife and carefully deposited on the chorioallantois at the site of the large membrane vessels. The shell window was framed with hot paraffin and sealed hermetically with a cover glass. The opening made by the needle over the air bubble was also closed with paraffin. The egg was then placed in an incubator held at a temperature of 38 C.

Twenty-four hours later the cover glass was lifted and 0.2 cc. (containing 300 Oxford units) of a solution of penicillin was instilled on the chorioallantoic mem-

From the Department of Ophthalmology, Rothschild Hadassah University Hospital, and the Department of Experimental Pathology, the Hebrew University.

1. Goodpasture, E. W.; Douglas, B., and Anderson, K.: Study of Human Skin Grafted Upon Chorio-Allantois of Chick Embryos, J. Exper. Med. **68**:891, 1938.

2. Goodpasture, E. W., and Buddingh, G. J.: Preparation of Antismallpox Vaccines by Culture of Virus in Chorio-Allantoic Membrane of Chick Embryos, and Its Use in Human Immunization, Am. J. Hyg. **21**:319, 1935.

brane near the graft. This procedure was repeated forty-eight hours later. Usually after six days the experiments were concluded. After the cover glass was removed and the shell window widened, the graft was excised, together with the adherent chorioallantoic membrane. The excised specimen was spread on filter paper, fixed in Zenker's solution and embedded in a paraffin-pyroxylin mixture; and the sections were stained with hematoxylin and eosin and with Mallory's anilin blue stain for collagen.

All manipulations were carried out with aseptic precautions. Before and after the grafting, bacteriologic tests were performed.

OBSERVATIONS

Macroscopic Appearance.—At the end of the six day period of incubation the conjunctival graft could be clearly seen as a button-like prominence, recognizable by its pinkish color. In the region of the graft, the vessels of the chorioallantoic membrane were distinctly widened and appeared to be more numerous. The graft was either wholly adherent with a broad base or protruded mushroom-like on a more or less broad pedicle (fig. 1).

Microscopic Appearance.—Histologic examination revealed a number of peculiarities of the epithelium of the conjunctiva, the subepithelial tissue and the blood vessels of the conjunctival transplant, as well as the adjacent chorioallantoic membrane; these will be described in detail.

Epithelium: The epithelial cover of the transplanted piece of conjunctiva in most cases was well preserved. In some instances it appeared in its normal thickness; in others it was thickened (fig. 2); chiefly, however, it was thinned so as to form now and then only one layer (figs. 3 and 6). The cellular architecture of the epithelium, although in places preserved without change, was usually altered, the arrangement in layers not being always clearly discernible. In both the thickened and the thinned portions of the epithelium the regular position of the nuclei was disturbed and the normally vertical position of the nuclei of the surface layer was missing from the picture. When the epithelium was thinned, the axes of the cell nuclei were more or less parallel with the surface.

The individual epithelial cell fairly constantly presented a normal appearance, with unchanged structure of the nucleus and the cytoplasm, and showed normal staining capacity. The individual cell was usually well demarcated; sometimes, however, especially in the deeper layers, the cell membrane became indistinct, the cells coalescing to form a syncytium. Frequently the cells of the epithelial cover appeared dissociated. The surface epithelial layer was often interspersed with normal mucus-containing goblet cells (figs. 3 and 4 *C*).

There was no distinct division between the epithelium and the subepithelial tissue in the majority of cases. The border was often indented, groups of epithelial cells seeming to penetrate rather deeply

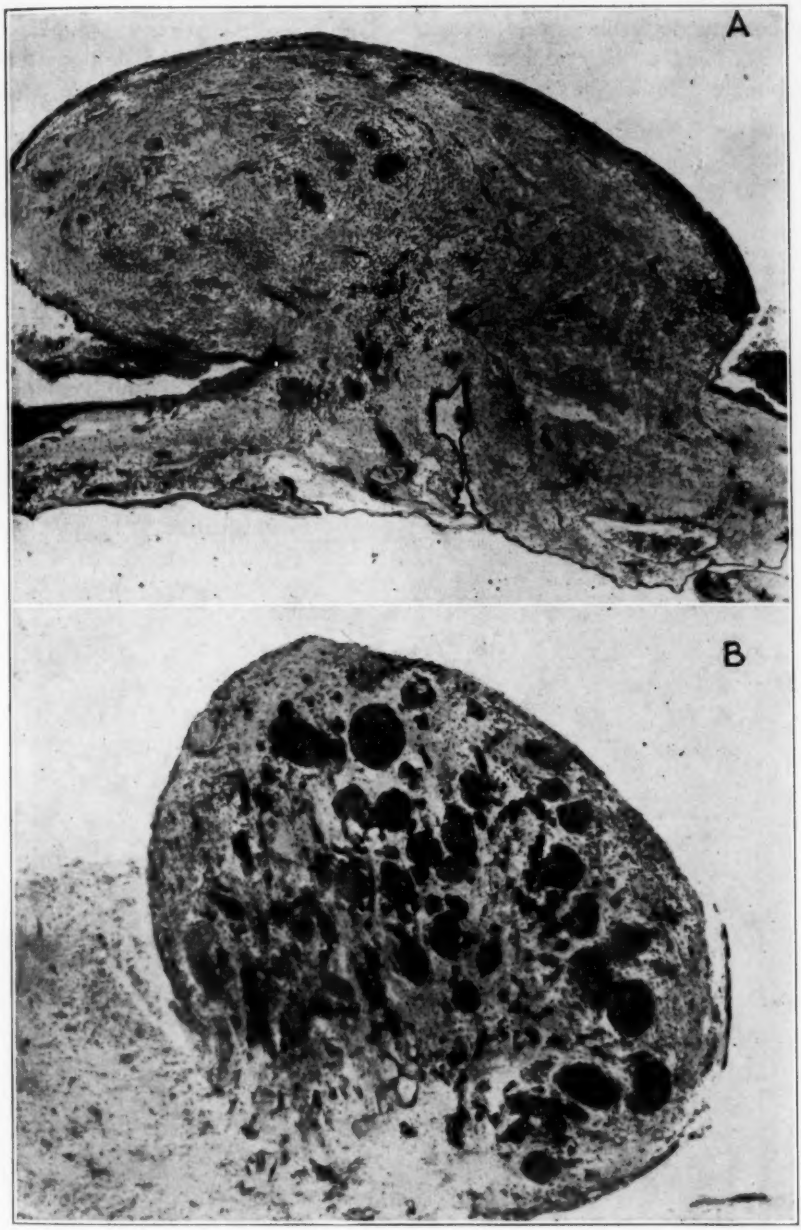

Fig. 1.—*A*, mushroom-like conjunctival graft on chorioallantois seven days after transplantation. Hematoxylin-eosin stain; × 31.

B, pedunculated conjunctival graft five days after transplantation, showing a great number of wide blood vessels engorged with chick erythrocytes. Hematoxylin-eosin stain; × 60.

into the subepithelial tissue. These epithelial downgrowths were solid or contained cystlike spaces.

Frequently, the epithelial cover was infiltrated with chick polymorphonuclear leukocytes (figs. 3 and 7). Here and there were seen

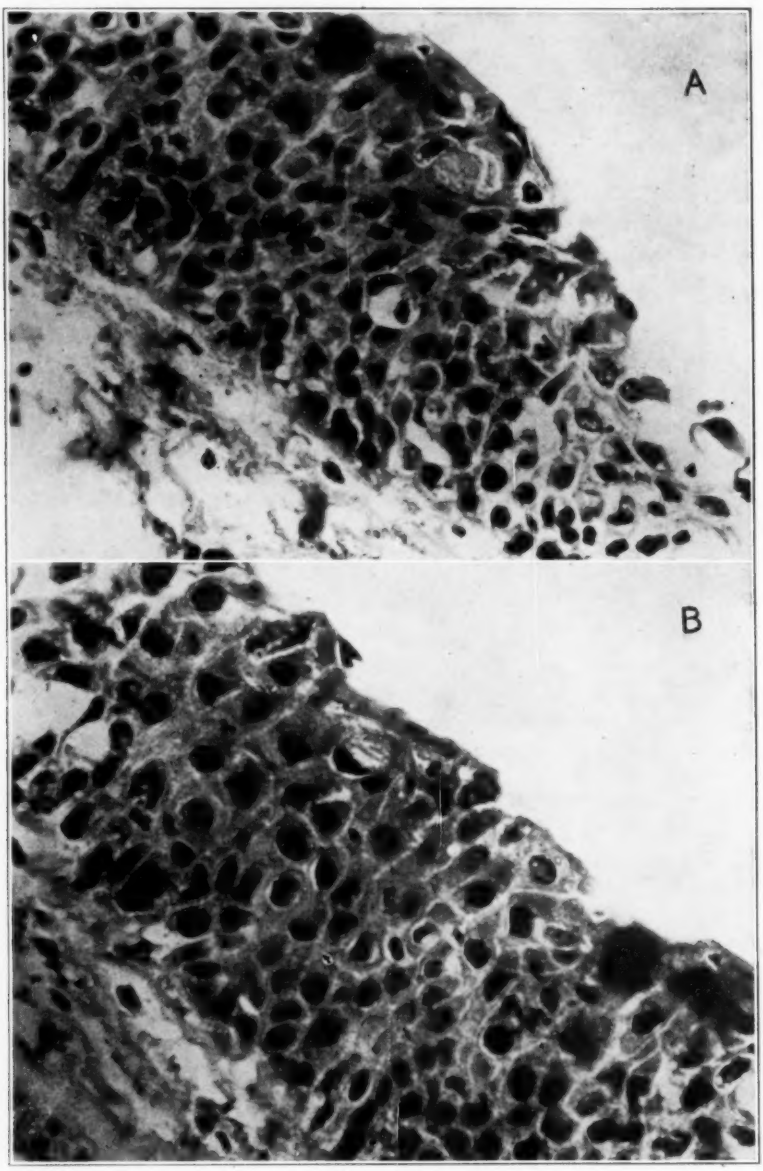

Fig. 2.—*A*, conjunctival graft five days after transplantation, showing greatly thickened epithelial layer. Hematoxylin-eosin stain; × 605.

B, Section similar to *A*.

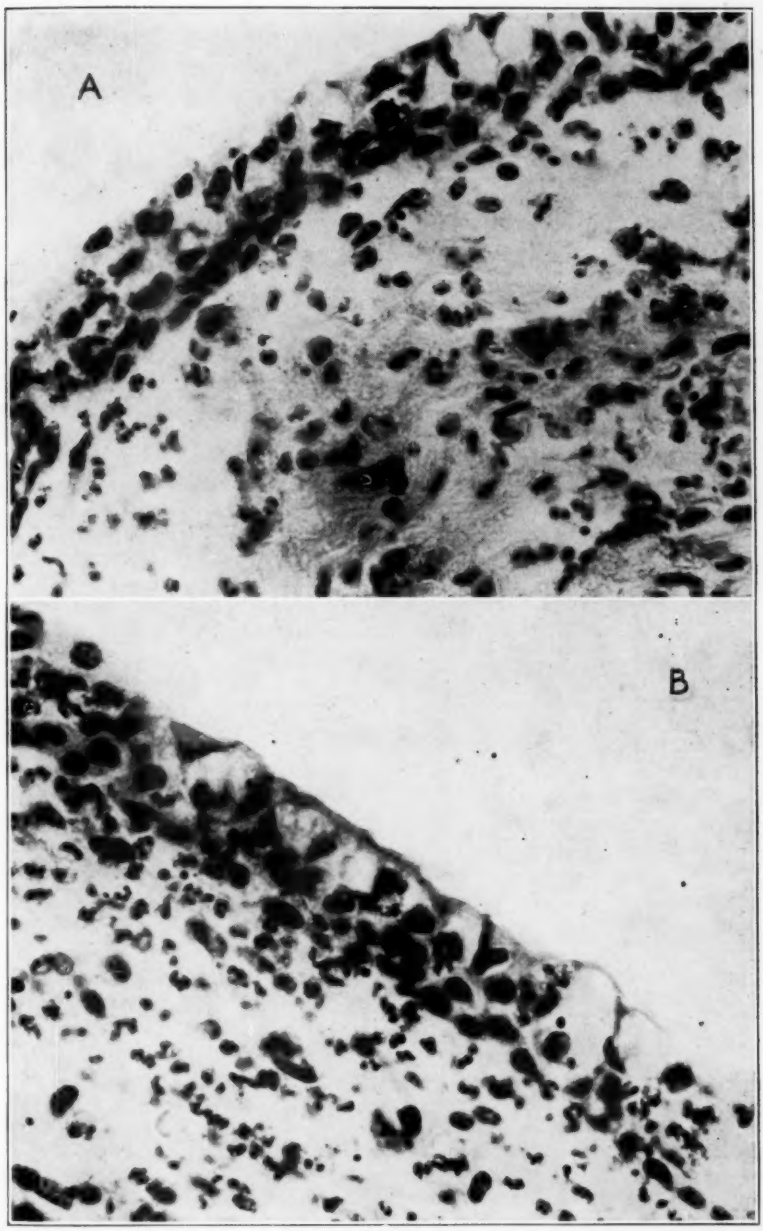

Fig. 3.—*A*, conjunctival graft five days after transplantation, showing epithelial layer with numerous goblet cells and leukocytic infiltration of subepithelial tissue. Hematoxylin-eosin stain; × 610.

B, Section similar to *A*; × 500.

cystlike spaces in various layers of the epithelium, filled with leukocytes (fig. 7 *B*). Occasionally intracellular leukocytes, chiefly within large vacuoles, were seen in dissociated epithelial cells (fig. 4 *D*). In several grafts, however, there was no leukocytic infiltration. Numerous mitotic figures were noted in all layers of the conjunctival epithelium (fig. 4 *A* and *B*).

Subepithelial Conjunctival Tissue: The subepithelial connective tissue was usually well preserved, showing a variable content of cells, the fixed connective tissue cells being generally enlarged and swollen

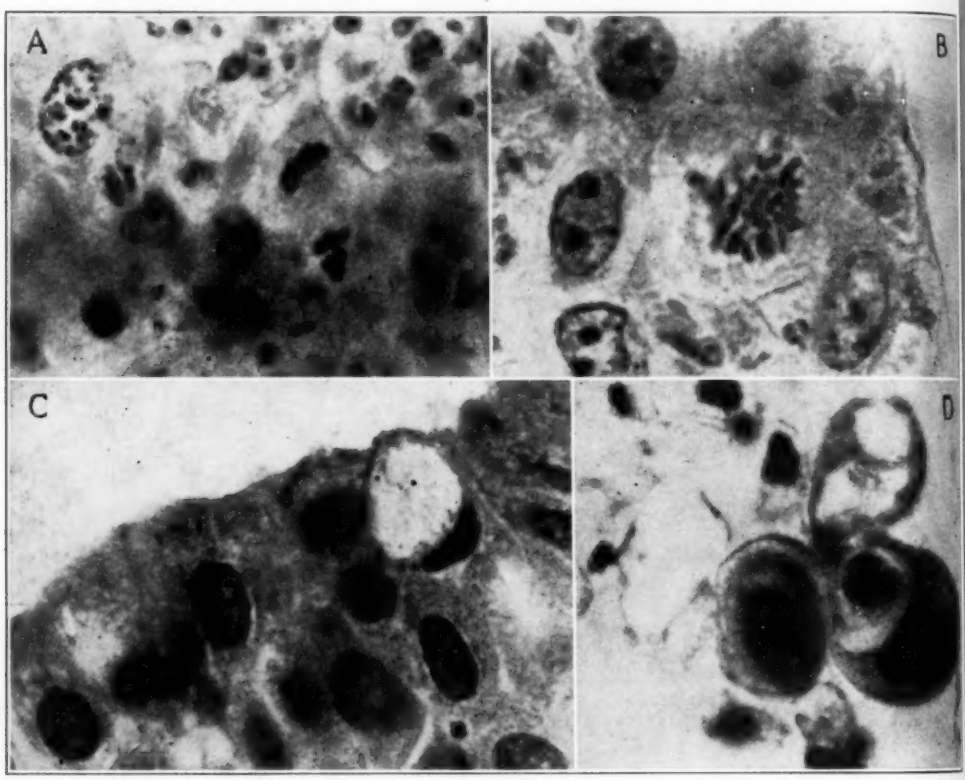

Fig. 4.—*A*, conjunctival graft five days after transplantation showing mitoses in the epithelium. Hematoxylin-eosin stain; × 1,200.

B, conjunctival graft five days after transplantation, showing mitosis in an epithelial cell. Hematoxylin-eosin stain; × 1,775.

C, conjunctival graft six days after transplantation, showing surface epithelial layer with a goblet cell. Hematoxylin-eosin stain; × 1,360.

D, conjunctival graft six days after transplantation, showing a group of dissociated epithelial cells, one of them containing a polymorphonuclear leukocyte situated in a vacuole. Hematoxylin-eosin stain, × 1,365.

(fig. 5). The number of mononuclear cells was not increased. The stroma contained a dense meshwork of collagen fibers; often it presented a hyalin appearance. The transition from the subepithelial connective

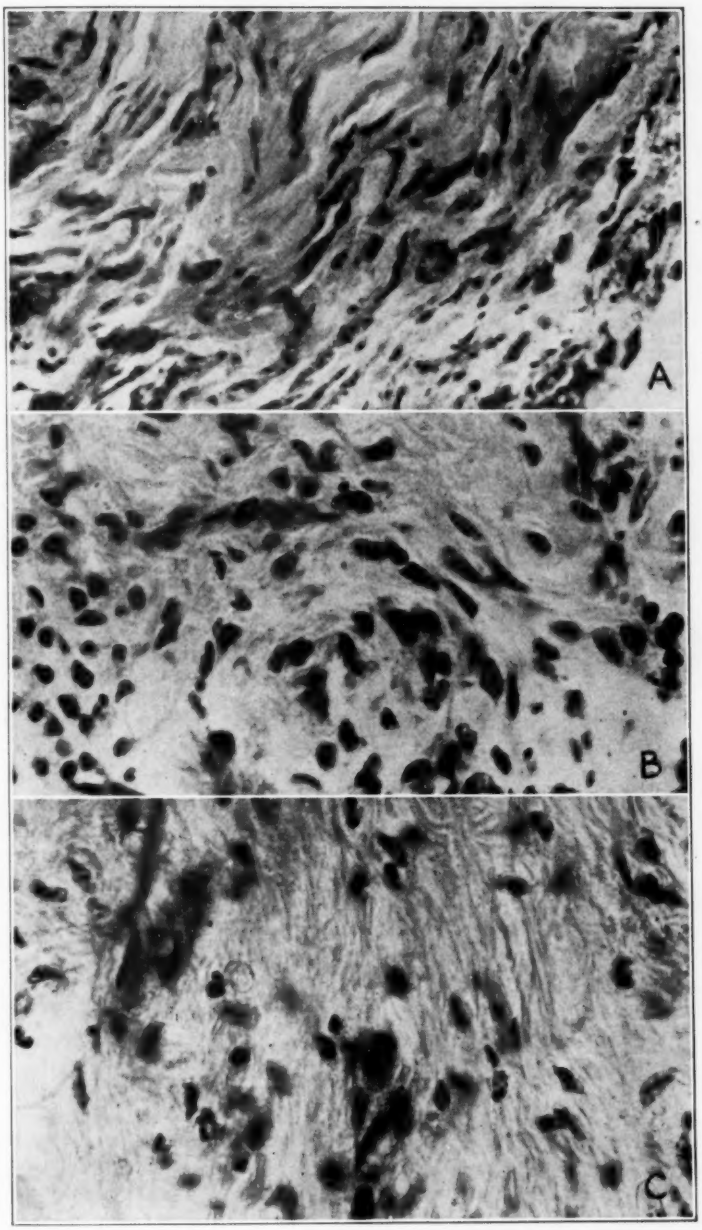

Fig. 5.—*A*, *B* and *C*, conjunctival grafts six days after transplantation, showing subepithelial connective tissue with varying cellular content. Hematoxylin-eosin stain; × 640.

tissue into the mesodermal fibrous tissue of the membrane was continuous.

In a considerable number of grafts a scanty infiltration with polymorphonuclear leukocytes was observed, the cells accumulating mainly at

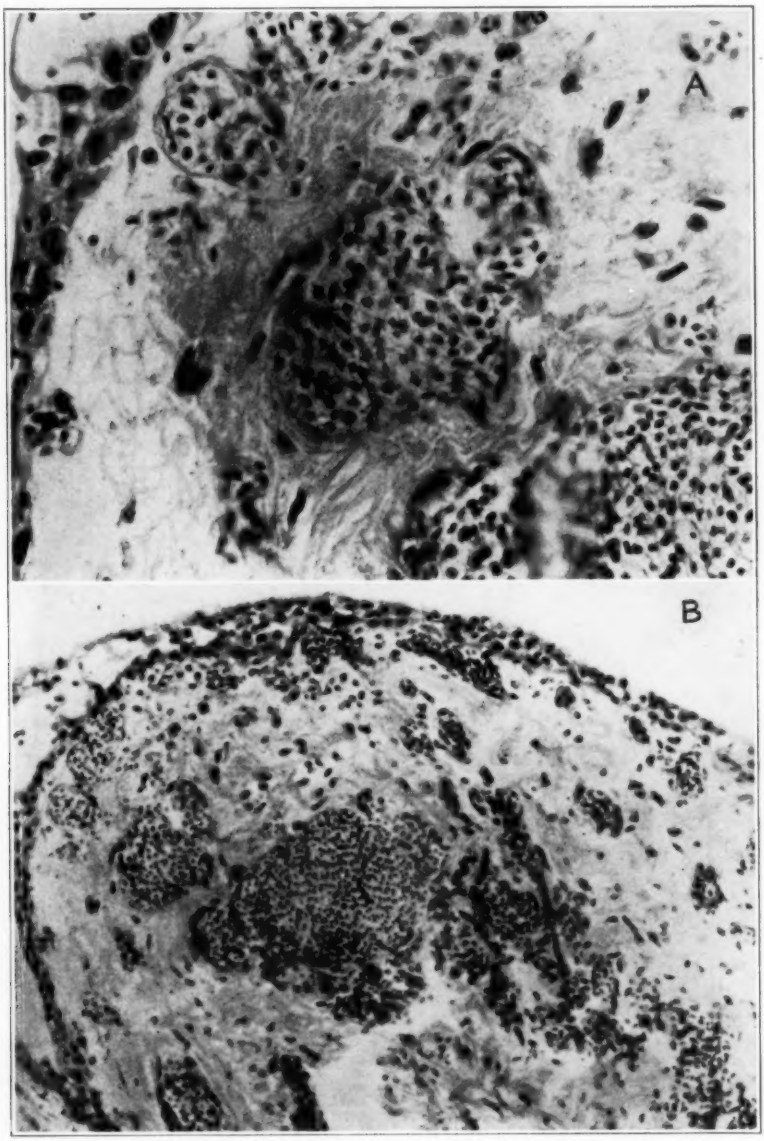

Fig. 6.—*A*, conjunctival graft six days after transplantation. Blood vessels containing chick erythrocytes reach the epithelium. Hematoxylin-eosin stain; × 400.

B, section similar to *A*; × 190.

the border between the epithelium and the subepithelial tissue (fig. 6 *C*). Sometimes the infiltration was massive and the epithelium appeared elevated, as by a vesicle (fig. 7 *A*). In some of the grafts small and sharply delimited necrotic areas were encountered within the subepi-

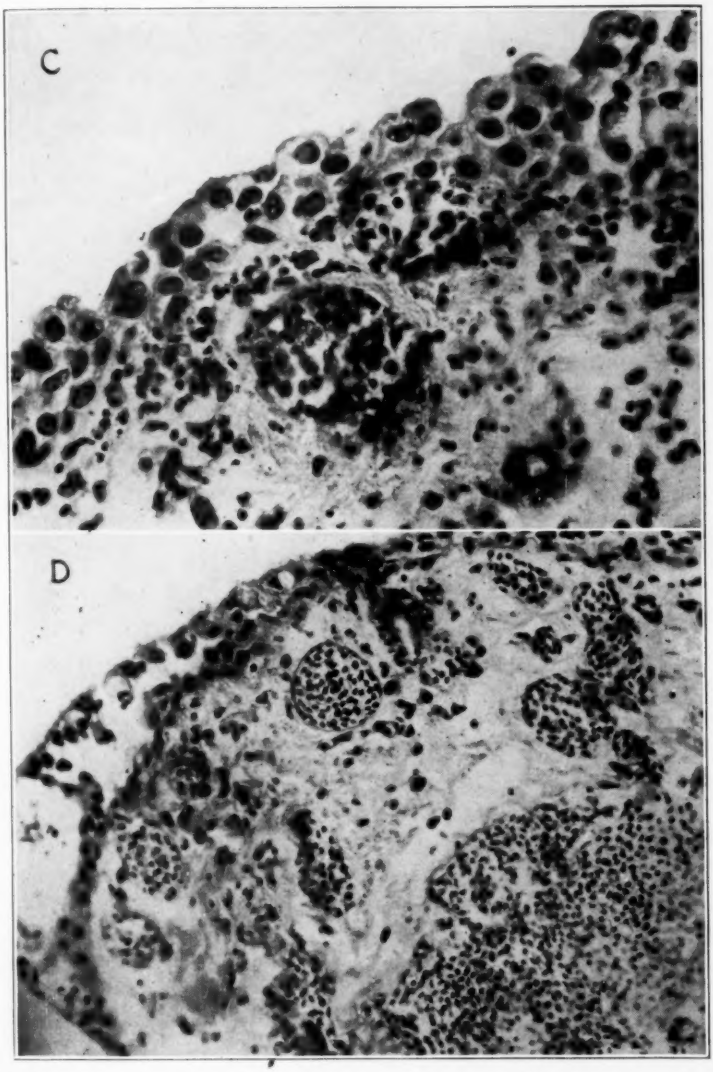

Fig. 6 (cont.).—*C*, section similar to *A*; × 520. *D*, section similar to *A*; × 240.

thelial tissue. Frequently the tissue was entirely free from leukocytic infiltration.

Blood Vessels: The grafts fairly constantly showed an abundance of wide capillaries (fig. 1 *B*). It could easily be perceived that the capil-

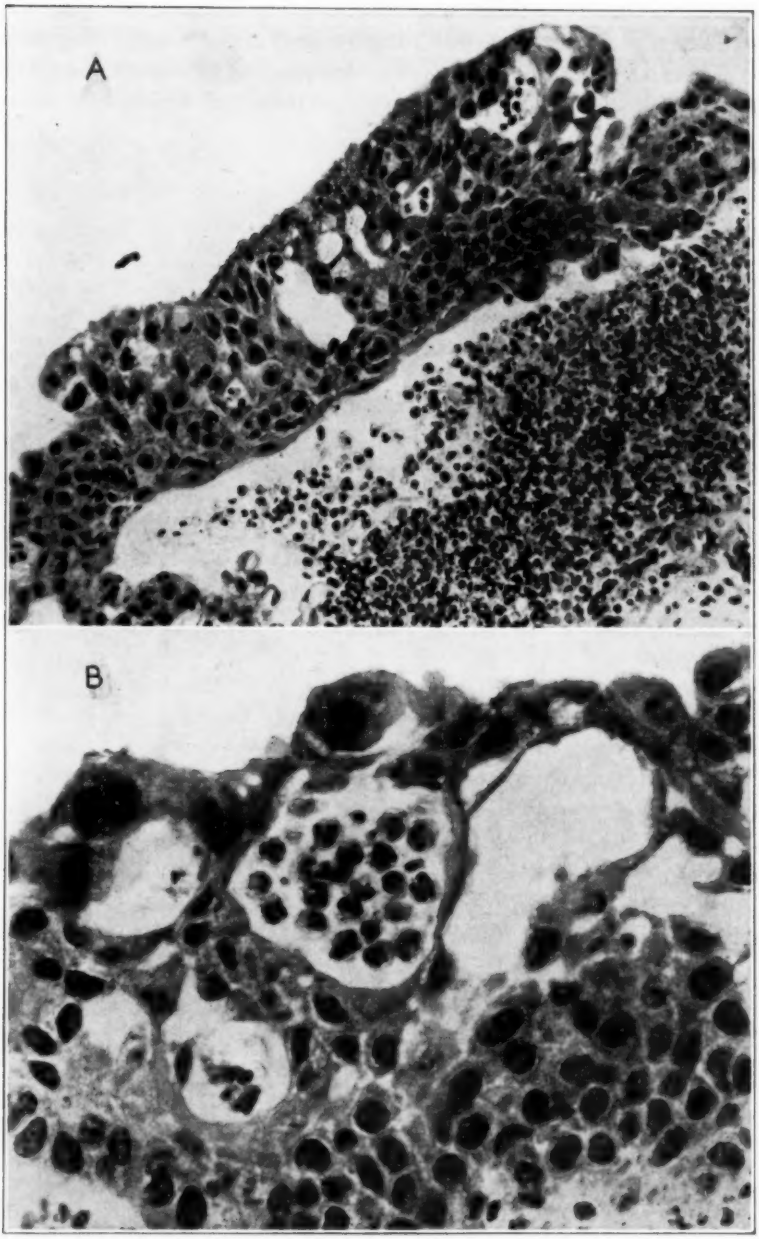

Fig. 7.—*A*, conjunctival graft six days after transplantation, with massive leukocytic infiltration beneath the epithelial cover and cystic spaces within the epithelium. Hematoxylin-eosin stain; × 295.

B, conjunctival graft six days after transplantation, with cystic spaces within the epithelial layer, some of them containing polymorphonuclear leukocytes. Hematoxylin-eosin stain; × 700.

laries of the graft were one with the capillaries of the chorioallantoic membrane. The capillaries arising from the chorioallantois penetrated the graft, approaching the epithelium, and some of the finest branches even invaded the epithelial cover (fig. 6).

The capillaries of the graft were lined with endothelial cells, which at times were flat and at others cubical. The capillaries were engorged with nucleated chick red blood cells. Here and there vessels contained human red blood cells, and occasionally erythrocytes of both species persisted in the lumens of the capillaries.

Chorioallantoic Membrane: Where the graft became adherent, the chorioallantois completely lost its ectodermal cover. At the margin of the graft the chorioallantoic ectoderm joined the conjunctival epithelium, each maintaining its own character. The chorioallantois remained in most cases well preserved, showing no reactive changes even when the graft became necrotic. Only rarely were there seen necrotic areas, walled off with giant cells, or foci of infiltration with polymorphonuclear leukocytes. Numerous epithelial pearls of various sizes were observed at different levels of the chorioallantoic membrane, but sometimes they were entirely absent.

COMMENT

The experiments reported here show that it is possible to maintain human conjunctiva in fairly healthy condition outside the body by grafting conjunctival fragments onto the chorioallantoic membrane of developing chick embryos. These grafts, examined after a period of five to six days, showed that all tissue elements of the conjunctiva were without substantial alteration.

The survival of the transplanted conjunctiva on the chorioallantoic membrane is due, no doubt, to the fact that the graft is quickly incorporated into the vascular system of the chorioallantois, from which it derives a continuous nutritional supply. In the achievement of this close connection an important role is played both by the extraordinary abundance of blood vessels in the chorioallantois and by the loose texture of the subepithelial connective tissue of the conjunctiva. Numerous proliferating capillaries invade the graft, reach the epithelium and frequently even penetrate its layers. The frequent observation of both human and nucleated chick erythrocytes in the vessels of the graft suggests that the vascular system of the conjunctiva has become connected with that of the chick embryo.

The rich nutritional supply granted by quick and abundant vascularization creates conditions enabling the conjunctiva to survive in its entirety. Both conjunctival layers, the epithelium and the subepithelial tissue, retain their structure and show no regressive changes. In the epithelium numerous mitoses are encountered.

The pathologic feature noted most frequently in the conjunctival graft is the infiltration with polymorphonuclear leukocytes, which is usually moderate but may sometimes become intense. There is no doubt that the leukocytes infiltrating the graft originate in the chick embryo. As the infiltration occurs in sterile grafts, its frequent incidence cannot be interpreted otherwise than as a response of the host to the foreign tissue. It is remarkable that this infiltration apparently does not interfere with the survival and maintenance of the graft.

The changes just described refer to successful grafts, but it must be emphasized that successful "takes" were in no way the general rule. The main obstacle, not easily overcome, is the microbial flora of the conjunctiva. After transplantation, the native micropopulation of the conjunctiva, originally limited in number, causes infection of the chick embryo, leading finally to distintegration of the graft and death of the host. Although penicillin is a powerful agent in controlling the bacterial infection, it fails in some cases (penicillin-resistant microbes).

A further disturbing feature is the tendency of some grafts to sink into the mesoderm of the membrane. Such grafts as a rule eventually become necrotic.

In spite of these unfavorable factors, the number of successful "takes" is sufficiently large to warrant experiments on a larger scale without serious inconvenience. The method presented in this paper seems to offer possibilities of a systematic study of histogenesis in the conjunctiva in various pathologic conditions, with the exclusion of somatic factors. The chief field of application of this method will most probably be the study of morbid conditions caused by viruses affecting the human conjunctiva, for whose maintenance in vitro human tissue is indispensable.

SUMMARY

Experiments are reported in which fragments of human conjunctiva were grafted on the chorioallantoic membrane of developing chick embryos.

The technic, as well as the macroscopic and microscopic appearance of the graft, is described.

It is demonstrated that with this method of grafting onto chorioallantoic membrane it is possible to maintain human conjunctiva in fairly good condition during the experimental period (six to seven days). Both the epithelial and the subepithelial tissues appear well preserved. Numerous mitotic figures may be noted in the cells of the epithelial layer. In addition, the graft is largely invaded by blood vessels derived from the chorioallantois.

Infiltration of the graft with polymorphonuclear leukocytes is encountered frequently. This infiltration is due not to infection but to the

response of the host to the foreign tissue, and does not interfere with the survival of the graft.

The chief obstacle to be overcome in these experiments is native infection of the conjunctiva, which can be controlled only to a certain extent with the use of penicillin.

The method presented seems to offer possibilities of a systematic study, under conditions excluding somatic factors, of the histogenesis of pathologic changes of the conjunctiva in various diseases, especially those caused by viruses.

NOTE.—Only after completion of the paper did we become aware of experiments performed by Julianelle,[3] who grafted human conjunctival cells (from scrapings) containing demonstrable trachomatous virus on the chorioallantois of the developing chick embryo. The epithelial cells were observed to be proliferating, unaccompanied with multiplication of the virus itself.

Dr. L. Doljanski, head of the Department of Experimental Pathology, Hebrew University, was of great assistance during this investigation, and Mrs. Irma Parnes gave technical aid.

15 Abyssinian Street.

3. Julianelle, L. A.: Studies on the Infectivity of Trachoma: XII: Additional Observations on the Cultivability of the Virus, Am. J. Ophth. **26**:280 (March) 1943.

UNILATERAL SYPHILITIC PRIMARY ATROPHY OF THE OPTIC NERVES

An Anatomic Study of Two Cases

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UNILATERAL syphilitic primary optic nerve atrophy will almost always become bilateral if not treated properly. If, however, therapy is begun while the atrophy of the optic nerve is limited to one side, involvement of the normal eye may be prevented in a high proportion of cases.[1]

In my anatomic material of 12 cases of syphilitic primary optic nerve atrophy, death had occurred at a time when the atrophy was confined to one optic nerve in 2. The histologic study of the visual pathways in these 2 cases furnished the clue to the ultimate degeneration of the nerve fibers of both optic nerves.

REPORT OF CASES

CASE 1.—*Unilateral syphilitic primary atrophy of the optic nerve in a patient with dementia paralytica.*

A Negro woman aged 65 presented the characteristic symptoms of dementia paralytica without tabetic involvement of the spinal cord. There were syphilitic aortic insufficiency and roentgenographic evidence of beginning aneurysm of the arch of the aorta. An aneurysm of the right innominate artery was also present.

Both pupils were small and fixed to light. The patient, who showed advanced mental deterioration, did not complain of loss of vision, and atrophy of the left optic nerve went unnoticed by both the patient and the physician.

The Wassermann, Kahn and Kline reactions of the blood and the Wassermann reaction of the spinal fluid were positive. The Ross-Jones and Pandy tests gave a 4 plus reaction. The cell count of the spinal fluid was 202 per cubic millimeter. The colloidal gold test read 5555543210.

On account of the patient's advanced age and the presence of syphilitic involvement of the aorta, malarial and other antisyphilitic therapy was withheld. The patient died four months after admission of dementia paralytica, complicated by cardiovascular syphilis.

Postmortem Observations.—Several fine bands of the slightly thickened basilar arachnoid passed over both optic nerves and the optic chiasm. There was no sign

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1. Moore, J. E.; Woods, A. C.; Hopkins, H. H., and Sloan, L. L.: The Treatment of Syphilitic Primary Optic Atrophy, J.A.M.A. **111**:385 (July 30) 1938.

of constriction of or pressure on either of the optic nerves by the arachnoidal bands. The left optic nerve was reduced in volume and was grayish. The left side of the chiasm was also somewhat atrophic.

Histologic Examination.—Left, Atrophied, Optic Nerve: Demyelination was complete except for a small area of fairly normal-staining nerve fibers. This area was situated in the periphery and could be traced in this location throughout the length of the optic nerve (fig. 1). In the pia of the intracranial portion of the left optic nerve was much inflammatory exudate, consisting of lymphocytes and plasma cells. This exudate diminished rapidly along the course of the nerve through the optic foramen and was absent in the pia of the orbital portion. In the interior of the intracranial portion—both in the demyelinated part and, to a lesser degree, in the area with the still normal nerve fibers—there was perivascular round cell infiltration in the sheaths of the larger vessels and in the walls of the capillaries. Such inflammatory exudate was absent in the interior of the orbital portion of the left optic nerve.

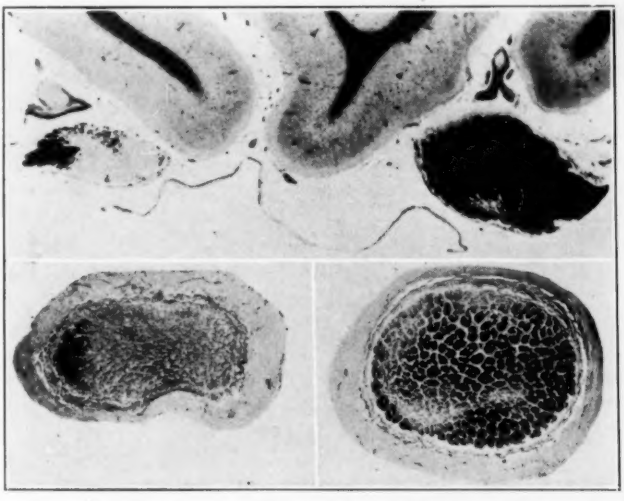

Fig. 1 (case 1).—Unilateral syphilitic primary atrophy of the optic nerve in a patient with dementia paralytica. The upper picture shows the base of the brain with the intracranial portions of both optic nerves. There is demyelination of most of the left optic nerve, which is much reduced in size. In the right optic nerve there is already a minute area of demyelination. The optochiasmatic arachnoid passes harmlessly over both optic nerves.

The lower picture represents the orbital portions of the left and right optic nerves. There is a small, peripherally arranged area with normal nerve fibers in the otherwise demyelinated left optic nerve. The right optic nerve shows beginning marginal demyelination, which extends at one place far into the interior of the nerve.

Right Optic Nerve: There was beginning marginal demyelination, which at one place extended a considerable distance into the interior of the nerve. In the pia of the intracranial portion a round cell infiltration, similar to that in the left, atrophied, optic nerve, was present but the exudate was much less intense. In the demyelinated marginal area there was moderate round cell infiltration, which continued in a slighter degree throughout the diameter of the optic nerve.

Optic Chiasm: At the level where the two optic nerves merged with the chiasm there was about the same pronounced degree of round cell infiltration in the pia of the two nerves. A somewhat smaller amount of exudate was present in the pia of the chiasm. However, within the chiasm plasma cells and lymphocytes could be detected only with the use of high power objectives. The cells were scattered in an even fashion throughout the entire width of the chiasm, with less syphilitic infiltration in the interior of the chiasm than in the optic nerves. The large scale degeneration of nerve fibers of the left optic nerve could be traced through the chiasm and into the optic tracts.

Optic Tracts: Both optic tracts showed demyelination chiefly in the margin, as the result of ascending degeneration. The left optic tract revealed this marginal degeneration all around the tract, while the right optic tract showed marginal degeneration only along the lateral side. In the meninges of both optic tracts was slight plasma cell infiltration, and in the interior of the tracts an occasional round cell could be noted in the vascular sheaths.

Geniculate Bodies: The ganglion cells were well preserved. There was slight perivascular infiltration of the vessels.

Base of Brain: In the pia of the floor of the third ventricle, i.e., immediately behind the optic chiasm, there was a slight inflammatory exudate.

Optochiasmatic Arachnoid: The slightly thickened arachnoid passed innocuously over both optic nerves without being adherent to either of them (fig. 1). There was no sign that the optochiasmatic arachnoid had constricted the left, atrophied, optic nerve. Only a few isolated round cells were noted in the arachnoid in this region.

Spirochetes were not observed in the visual pathways, but such organisms were demonstrated in the gray matter of the brain, which revealed the characteristic histopathologic picture of dementia paralytica.

In the spinal cord were no tabetic changes.

Comment.—The anatomic evidence, which could be pieced together from serial sections, pointed to the intracranial portion of the optic nerves as the starting point of the disease process. The syphilitic exudate in the interior of the nerves had reached its greatest intensity in the demyelinated portion of the left, atrophied, optic nerve. However, a similar, but less intense, inflammatory process was already present in the intracranial portion of the not yet demyelinated right optic nerve. One can safely assume that the exudative process in the already demyelinated left optic nerve has preceded, possibly by several years, the appearance of the syphilitic exudate in the interior of the other, not yet atrophied, nerve. Demyelination of nerve fibers in primary syphilitic optic nerve atrophy is, as a rule, an exceedingly slow process, being the result of a mild, but persistent, inflammation.

CASE 2.—*Unilateral syphilitic primary optic nerve atrophy in a patient with meningovascular syphilis.*

A policeman at the age of 53 had onset of meningovascular syphilis with mental symptoms. There was a history of chancre twenty years before, with no subsequent treatment. The patellar reflex was slightly exaggerated on both sides. Vision was 20/40 in the right eye. The left eye, at the time of his admission, had been

blind about one year. Perimetric examination of the right eye was unsatisfactory, owing to the disturbed mental state of the patient.

The Wassermann and Kahn reactions of the blood and the Wassermann reaction of the spinal fluid were positive. The Ross-Jones and Pandy tests gave a 4 plus reaction. The total protein was 156 mg. per hundred cubic centimeters. The cell count was 103 per cubic millimeter. The colloidal gold curve was 1234221100.

The patient was given a course of tertian malarial therapy. He experienced nine paroxysms of fever, with temperatures ranging from 103 to 105 F. There was no other treatment for syphilis. The patient showed some clinical improvement, but the spinal fluid remained practically unchanged. Even the cell count was uninfluenced by the course of therapeutic malaria, being 88 cells per cubic millimeter shortly before death.

Postmortem Observations.—Over the pons the arachnoid revealed chronic thickening, but in the optochiasmatic region it had a fairly normal appearance.

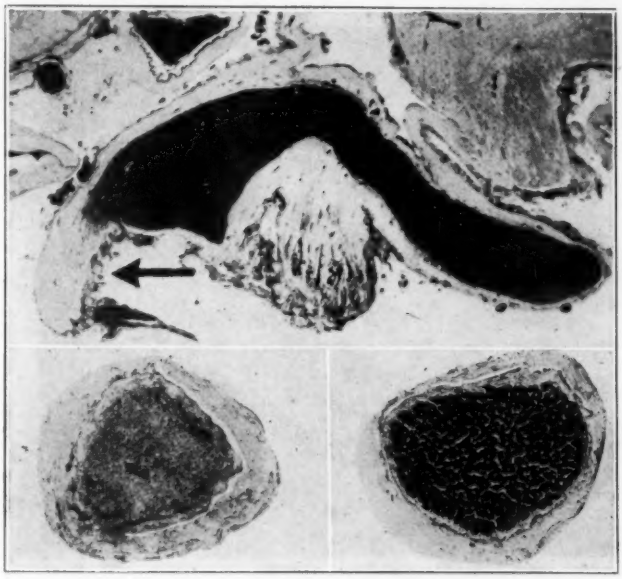

Fig. 2 (case 2)—Unilateral syphilitic primary atrophy of the optic nerve in a patient with meningovascular syphilis. The upper picture represents the optic chiasm. There is complete demyelination of the left lateral portion of the chiasm (arrow), where the left optic nerve emerges. In this region the inflammatory process has reached its greatest intensity. See figures 3 and 4.

Below is shown the orbital portions of the left (demyelinated) and the right (normal) optic nerve. Weil's stain for myelin sheaths.

Grossly, there was no indication of severe syphilitic basilar meningitis, as was later revealed by microscopic examination (figs. 3 and 4). Strikingly, the optic nerves were almost of the same volume, i.e., the atrophy of the left optic nerve was barely noticeable on gross examination. Over the temporal and lateral regions of the brain there was slight generalized meningeal turbidity, diminishing in intensity toward the upper aspect of the brain. In the left temporoparietal region several cortical infarctions occurred, as the result of syphilitic obliterating endarteritis.

There was beginning syphilitic aneurysm of the arch of the aorta.

Histologic Examination.—At the base of the brain, but particularly in the optochiasmatic region (figs. 3 and 4) there was much exudate (syphilitic basilar meningitis). On the other hand, the meninges of the upper aspect of the brain were free of inflammatory cellular elements. Numerous small and middle-sized vessels at the base of the brain revealed syphilitic panarteritis (fig. 4). There were no perivascular round cell infiltrations in the cortex of the brain. The microscopic diagnosis was meningovascular syphilis.

Optic Pathways: In serial sections it was observed that the most pronounced inflammatory reaction anywhere in the brain was situated in the anterior portion of the chiasm where the left optic nerve made its exit (figs. 3 and 4). Here, heavy round cell infiltrations, composed almost exclusively of lymphocytes, penetrated from the margin into the interior of the chiasm, flooding the nerve fibers and producing complete demyelination (fig. 2). A most careful and time-consuming

Fig. 3 (case 2).—Left lateral demyelinated portion of the optic chiasm. Syphilitic exudate is seen along the margin, penetrating into the interior of the chiasm. Toluidine blue stain.

search for spirochetes in this most infiltrated area, as well as in other parts of the optic pathways and in the brain, did not reveal Treponema pallidum. Throughout the remaining cross section of the chiasm there was also a diffuse inflammatory exudate, but obvious demyelination was still absent except in the margin of the chiasm. In the pia of the intracranial portion of both optic nerves there was moderate round cell infiltration, being slightly more pronounced in the atrophied than in the normal optic nerve. In the interior of the intracranial portion of the atrophied optic nerve there were lymphocytes and plasma cells, and the vessels were surrounded by a coat of similar cells. In the intraforaminal region the syphilitic exudate, both in the pia and in the interior, became less intense, and in the midorbital region was almost absent. In the margin, and less so throughout the diameter, of the intracranial portion of the right, normal, optic nerve there was

also round cell infiltration. But, except for the margin, this optic nerve did not show obvious signs of demyelination. In the midorbital portion of this nerve there was no longer any inflammatory reaction, either in the pia or in the interior. This was in contrast to the left, atrophied, optic nerve, where at the same level a few plasma cells could still be observed within the nerve.

In the pia of both optic tracts there was moderate round cell infiltration, and within the tracts occasional plasma cells could be observed.

In the geniculate bodies there were no changes.

Comment.—In this patient with meningovascular syphilis and unilateral atrophy of the optic nerve, the syphilitic meningitis was almost exclusively confined to the base of the brain. The meningitic exudate

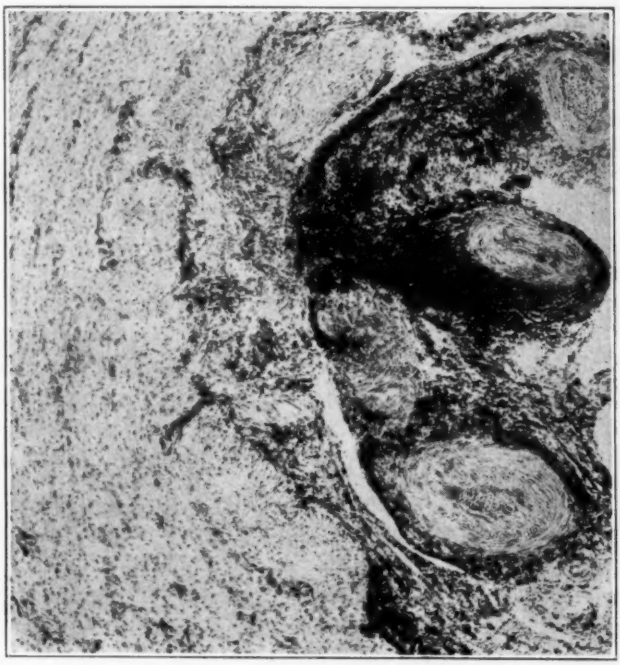

Fig. 4 (case 2).—Syphilitic basilar meningitis: Masses of lymphocytes and blood vessels indicate syphilitic endarteritis in the region where the left optic nerve makes its exit from the chiasm. Toluidine blue stain.

had reached its height over the left side of the anterior portion of the chiasm, where the left optic nerve emerges, having produced complete demyelination in this area. Since in most cases unilateral atrophy of the optic nerve becomes bilateral, it was of great interest to ascertain the degree of the inflammatory reaction in the nondemyelinated part of the chiasm and in the right, nonatrophied, optic nerve. In the not yet demyelinated portion of the chiasm and in the still normal optic nerve there was already at this stage enough syphilitic exudate to have led to

demyelination of the nerve fibers in the near future. A great deal has been written on the direct noxious action of spirochetes on the nerve fibers in optic nerve atrophy. For this reason, a most intensive search for spirochetes was made in the optic pathways and in other regions of the brain, but none were found.

From a therapeutic point of view, a most important question arose. A course of induced malaria had failed to reduce the increased cell count of the spinal fluid. In other words, the inflammatory process in the meninges had remained unaltered. It has since been shown that in such instances the subsequent use of 5,000,000 units of penicillin, given by the intramuscular route, will restore the cell count to normal. The therapeutic implication of this observation in the treatment of syphilitic optic nerve atrophy is clear. In its management one should not rely on induced malaria alone, or on penicillin alone. For the best possible effect on the underlying inflammatory process, malaria therapy and the simultaneous administration of 5,000,000 to 7,000,000 penicillin units, followed immediately by another course of 5,000,000 units, should be advocated. This suggestion [2] has already found adherence in one of the most progressive centers for treatment of syphilis.[3]

GENERAL COMMENTS

In by far the largest majority of cases of syphilitic primary optic nerve atrophy, both optic nerves are affected simultaneously, but frequently the process is more advanced on one side than on the other. In only 10 of 250 cases of the Johns Hopkins material was the atrophy of the optic nerve unilateral at the time of the initial examination.[4]

Histologic study in the 2 cases of unilateral syphilitic atrophy of the optic nerve has shown clearly why, with few exceptions, unilateral optic nerve atrophy is almost always followed by bilateral involvement. In both cases, at the time of death, there was present in the not yet demyelinated optic nerve an exudative process which was considered sufficient to bring about demyelination in due time.

Involvement of the unaffected nerve may in occasional patients be very slow. Moore and associates [4] observed 5 patients with unilateral optic nerve atrophy who maintained normal visual acuity in the unaffected eye for three or more years without treatment. In a rare case the process may remain monocular for as long as six to twelve years.[4] In such an

2. Bruetsch, W. L.: Malaria Therapy in Syphilitic Primary Optic Atrophy, J. A. M. A. **130**:14 (Jan. 5) 1946.

3. Moore, J. E.: Penicillin in Syphilis, Springfield, Ill., Charles C Thomas, Publisher, 1946, pp. 200 and 273.

4. Moore, J. E.; Hahn, R. D.; Woods, A. C., and Sloan, L.: The Treatment of Syphilitic Primary Optic Atrophy, Am. J. Syph., Gonor. & Ven. Dis. **26**:407, 1942.

instance the inflammatory process is apparently strictly limited to the intracranial portion of one optic nerve. Such a case was studied by Richter,[5] who observed, on histologic examination, one optic nerve with normal nerve fibers and no round cell infiltration in the pia or in the interior of the nerve. The other optic nerve was atrophied. In this nerve there was a large amount of exudate in the pia and in the septums. The chiasm and optic tracts were free of an inflammatory process. This instance is an excellent example of the theory [6] that demyelination in primary syphilitic optic nerve atrophy is dependent on inflammation.

A few words should be said as to the role of the optochiasmatic arachnoid in the causation of optic nerve atrophy. Of late, the theory has been advanced that syphilitic arachnoiditis involving the optic nerves is responsible for the atrophy of the optic nerves.[7] In neither of the 2 cases with unilateral atrophy of the optic nerve was there pronounced thickening of the arachnoid in the optochiasmatic region, nor was there any evidence of mechanical constriction about the atrophied optic nerves. In an extensive anatomic study of primary syphilitic optic nerve atrophy I[8] have definitely disproved this theory. In 5 of 10 cases of complete syphilitic optic nerve atrophy of my material there were no arachnoidal adhesions at all in the optochiasmic region. In the other instances there was syphilitic arachnoiditis, but the arachnoidal thickening was merely an incidental change, and could not be connected with the atrophy of the optic nerves.

CONCLUSIONS

Unilateral syphilitic primary atrophy of the optic nerve is almost always the forerunner of bilateral atrophy of this nerve. At the time the demyelination of the nerve fibers has progressed to complete degeneration in one optic nerve, there is already present in the normal nerve a syphilitic inflammatory exudate which ultimately will lead to atrophy of the not yet demyelinated optic nerve.

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5. Richter, H.: Zur Histogenese der Tabes, Ztschr. f. d. ges. Neurol. u. Psychiat. **67**:1, 1921.

6. Bruetsch, W. L.: The Pathogenesis and Pathology of Syphilitic Primary Optic Atrophy, Am. J. Syph., Gonor. & Ven. Dis., to be published.

7. Vincent, C.; Jeandelize, and Bretagne: Atrophie optique tabétique et neuro-chirurgie, Bull. Soc. d'opht. de Paris **49**:245, 1937. Vail, D.: Syphilitic Opticochiasmatic Arachnoiditis, Tr. Am. Ophth. Soc. **36**:126, 1938. Hausman, L.: The Surgical Treatment of Syphilitic Optic Atrophy Due to Chiasmal Arachnoiditis, Am. J. Ophth. **24**:119, 1941. Schaub, C. F.: Surgical Treatment of Syphilitic Optic Atrophy (Syphilitic Optico-Chiasmatic Arachnoiditis), Dis. Eye, Ear, Nose & Throat **1**:326, 1941.

8. Bruetsch, W. L.: Surgical Treatment of Syphilitic Primary Optic Atrophy (Syphilitic Optochiasmatic Arachnoiditis), Tr. Am. Neurol. A. **71**:129, 1946; Surgical Treatment of Syphilitic Primary Optic Nerve Atrophy (Syphilitic Optochiasmatic Arachnoiditis), Arch. Ophth. **38**:735 (Dec.) 1947; The Etiology of Optochiasmatic Arachnoiditis, Arch. Neurol. & Psychiat., to be published.

Syphilitic optochiasmatic arachnoiditis, which is frequently present in neurosyphilis, has nothing to do with the causation of the atrophy of the optic nerves.

The most efficacious treatment of syphilitic optic nerve atrophy is malarial therapy, aided by concomitant and subsequent courses of penicillin, each course consisting of administration of at least 5,000,000 units.

ABSTRACT OF DISCUSSION

Dr. C. S. O'Brien, Iowa City: The atrophy of the optic nerve associated with untreated neurosyphilis is almost invariably bilateral. Although degenerative changes in one nerve may manifest themselves clinically long before apparent involvement of the other nerve, one must never base an opinion of atrophy of the optic nerve on ophthalmoscopic studies alone, inasmuch as early degenerative changes are not visible and therefore early diagnosis must be made on defects in the visual fields. The pathologic observations in each case described by Dr. Bruetsch establish the fact that both nerves were involved even though he entitled his paper "Unilateral Syphilitic Primary Optic Atrophy." It is probable that had it been possible to make satisfactory studies of the visual fields on the better eye of each patient, the patient with dementia paralytica would have shown concentric contraction with a sector defect in the field, since pathologic studies revealed inflammation and beginning peripheral demyelination with extension in one area into the interior of the nerve. The patient with meningovascular syphilis would have had some concentric contraction of the visual field, since microscopically the nerve showed marginal demyelination.

The pathogenesis of syphilitic primary atrophy of the optic nerve is still a moot point. This is due to the fact that almost never has it been possible to demonstrate Treponema pallidum either in the leptomeninges surrounding the nerve or in the nerve itself. A definite toxin may be present, but its presence has not yet been proved. Some believe that the degeneration of the nerve is secondary to vascular lesions, with resultant lack of nutrition. Others have postulated a combination of syphilitic disease and vitamin B deficiency. Still other theories have been propounded. All such explanations seem unnecessary, since the degeneration of the nerve fibers may be accounted for on the basis of chronic leptomeningitis and interstitial neuritis. Such being the case, the optic nerve atrophy of neurosyphilis is not in reality primary, but is a secondary type, due to peripheral and interstitial neuritis, beginning usually in the intracranial portion of the nerve and manifesting itself on ophthalmoscopic examination as a primary atrophy only by reason of a descending degeneration without visible inflammatory changes in the nerve head.

In all types of neurosyphilis the pathologic process of optic nerve atrophy is essentially the same, i. e., a peripheral and an interstitial inflammation, followed by gliosis with demyelination and degeneration of the nerve fibers. Moore and Woods [4] expressed the belief that pathologic changes in the optic nerves begin in the intracranial portion just anterior to the chiasm as leptomeningitis and interstitial neuritis and that degenerative changes appear first in the marginal nerve fibers.

This is demonstrated in the 2 cases under discussion. Dr. Bruetsch stated [2] that his findings in 70 cases of neurosyphilis confirmed the conclusions reached by others before him, namely, that in the optic nerve atrophy of tabes, dementia paralytica, the tabetic form of dementia paralytica and meningovascular syphilis there are a chronic, low grade inflammatory process in the pia-arachnoid surrounding the nerve and a similar process in the nerve septums, followed by demyelination and atrophy of the nerve fibers and secondary gliosis. In dementia paralytica and in meningovascular syphilis, the meninges and brain in the region of the anterior pole are affected more severely than in other areas; hence, as one would expect, the chiasm and the intracranial portion of the optic nerves are usually involved more than the orbital portion of the nerves. In the 2 cases reported here the pathologic changes are therefore typical. Indicative of the chronic, sluggish nature of the inflammation are the perivascular round cell infiltrations, composed of lymphocytes and plasma cells, in the pia-arachnoid and nerve septums.

Dr. Bruetsch seems to be convinced that optochiasmatic arachnoiditis need not be considered as a cause of syphilitic atrophy of the optic nerve. However, it is believed that further study is necessary before one can be sure that it may not be the etiologic factor in an occasional case of atrophy of the optic nerve.

The modern treatment of syphilitic optic nerve atrophy is based on the belief that inflammatory changes precede, and are responsible for, degeneration of the nerve fibers. Malaria and penicillin are effective agents against syphilitic inflammation; and, while they will not restore degenerated nerve fibers, they will prevent additional damage after control of the inflammatory process. The fact that this form of therapy arrests the progress of the atrophy lends support to the theory that degeneration of the nerve fibers is due to peripheral and interstitial neuritis.

Dr. Joseph V. Klauder, Philadelphia: I am sure all appreciate Dr. Bruetsch's excellent and painstaking studies. Aided by improved methods of staining, enthusiasm and, above all, skill, he has gone further in pathologic studies of optic nerve atrophy than has any other investigator.

Dr. Bruetsch's thesis is that syphilitic primary atrophy of the optic nerves is an inflammatory process. The starting point of such a process is the intracranial portion of the nerves. Inflammatory symptoms are conspicuous around the chiasm and were present around both nerves in the 2 cases he studied, although only one nerve showed demyelination. In the histopathologic concept, therefore, the atrophy was bilateral. It was unilateral only in the clinical concept. The inflammatory process is at first extraneural and later becomes intraneural, preceding demyelination of the nerve.

Dr. Bruetsch's studies have interesting clinical correlations. He demonstrated in 1 case that inflammatory processes invading the nerve prior to demyelination caused constriction of the visual fields. Improvement in the degree of construction followed treatment. Heretofore, one questioned such an occurrence, in the belief that degenerated nerve fibers cannot be restored. The answer is that in such cases the optic nerve is not atrophied or demyelinated.

The author observed optochiasmatic arachnoiditis; in none of his cases, however, was it of sufficient degree that cicatricial bands constricted the optic nerves. His studies bring into question this alleged cause of atrophy of the optic nerve and therefore challenge the justification of surgical procedures in treatment.

It would be of interest to know the duration of the stage of optic nerve atrophy recognizable by objective evidence—the ophthalmoscopic findings and perimetric fields—which precedes the subjective symptom of impaired visual acuity. My clinical impression is that the duration of this stage varies from a few months to as long as several years and that in 5 per cent of all cases of neurosyphilis or acquired syphilis of more than ten years' duration the optic nerve atrophy can be diagnosed in the stage of presubjective symptoms.

Unilateral atrophy of the optic nerve is rarely seen among the clinic patients at Wills Hospital. The reason becomes obvious in considering the data compiled by Lehrfeld and Gross (*Am. J. Ophth.* **21**: 435, 1938) on 600 patients with primary optic nerve atrophy of syphilitic origin at Wills Hospital. At the onset of impaired visual acuity 31 per cent of these patients consulted an optometrist as an initial means of treatment. An average of eighteen months elapsed between the onset of impaired vision and proper treatment. When first seen at the clinic, 64 per cent had visual acuity of 6/24 or less and 19 per cent had visual acuity of 6/60 or less.

This is our unfortunate experience in the early diagnosis of optic nerve atrophy at this clinic. Apparently the optometrist sees one-third more patients with early atrophy of the optic nerve than does the ophthalmologist. I could make a point of this observation in favor of having the optometrist trained to recognize papillary abnormalities as indicative of syphilitic optic nerve atrophy and refer such patients for proper study and treatment. It intimately concerns the discussion I have just heard concerning the teaching of optometrists by ophthalmologists.

There are important clinical implications in Dr. Bruetsch's studies. The vital importance of syphilitic optic nerve atrophy needs no emphasis. The 10 to 15 per cent of all blindness caused by syphilis (essentially optic nerve atrophy) approaches the incidence of blindness caused by cataract and glaucoma. Syphilis as a cause of blindness is deserving of as much attention as is now being given to glaucoma. I appeal to ophthalmologists for more interest in syphilis as a systemic disease, its public health aspects and its treatment.

The importance of early diagnosis and the need of antisyphilitic treatment, especially fever and penicillin, are clinical correlations of Dr. Bruetsch's studies. Undue pessimism that optic nerve atrophy always pursues an unfavorable course after treatment is not justified.

To facilitate early diagnosis, it is necessary that ophthalmologists and all physicians who examine syphilitic patients have a high degree of awareness of atrophy of the optic nerves, especially the tabetic type. Routine ophthalmologic examination should be conducted on all patients with neurosyphilis. In records of private, ward and clinic patients too frequently no mention is made of the status of the optic nerve unless the patient complains of impaired visual acuity. Especially in all clinics for syphilitic patients ophthalmologic examination should be facilitated.

Dr. Bruetsch's emphasis on use of fever and penicillin in treatment will, I am sure, find general agreement. I subscribe to initial treatment with 5,000,000 to 7,000,000 units given conjointly with induction of fever, but am not yet prepared to say in what amount and for how long penicillin should be administered. Further study is necessary to determine this. Frequently it is necessary to individualize treatment.

Results at Wills Hospital with penicillin treatment of optic nerve atrophy have been encouraging. Years of observation, however, will be required to define the status of the drug as a therapeutic agent.

Dr. Walter L. Bruetsch, Indianapolis: I should like to stress one point: Penicillin should be given as long as there is a trace of vision left. There is always the hope that the process may be arrested before the light goes out entirely.

Clinical Notes

STUDENTS' MODEL FOR DEMONSTRATION OF ACTION OF THE EXTRAOCULAR MUSCLES

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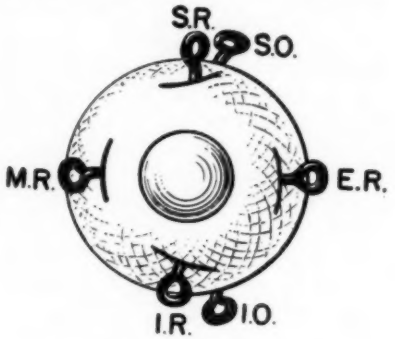
BOSTON

The varying action of the individual extraocular muscles in different positions of the eyes is often confusing to the student, and little enlightenment is to be found in texts, which categorically divide the actions into "primary" and "secondary," leaving the student to memorize the functions by rote.

Believing that a simple mechanical device may give the student a functional interpretation of the changing action, I have for the past several years had students make a golf ball model, which in its simplicity, cost and ease of construction has distinct advantages over the ophthalmotropes frequently used. It is described here in the belief that it may have some general usefulness in postgraduate teaching.



Golf ball model of the left eye.

A standard golf ball is just twice the size of the normal adult eye, and some standard furniture gliders are twice the size of the cornea. The glider prongs are hammered into the golf ball, and the insertions of the muscles are indicated with india ink on the globe (figure) at appropriate distances from the "limbus," according to the diagrams and measurements (doubled) given in Whitnall's text.[1] A screw eye is then placed at the midpoint of the insertion of each muscle.

To illustrate the action of any one muscle, a piece of string is attached to the corresponding screw eye; the golf ball is held between the thumb

From the Howe Laboratory of Ophthalmology, Harvard Medical School, and the Massachusetts Eye and Ear Infirmary.

1. Whitnall, S. E.: The Anatomy of the Human Orbit and Accessory Organs of Vision, ed. 2, New York, Oxford University Press, 1932.

and finger of one hand with the "cornea" facing in any desired direction, and the unattached end of the string is held with the other hand in the position from which the pull of that muscle is normally exerted on the globe. Traction on the string will then exert a pull corresponding to the normal action of the particular muscle. After a relatively few manipulations of the model, the student finds he can visualize the function of each muscle in various positions of the eye, without having to depend on an all too fickle, and often treacherous, memory.

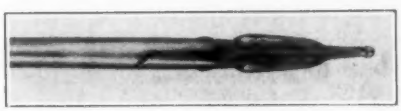
The model here described illustrates the actions of the muscles for one eye only. Conjugate movements may be simulated by making a model for each eye separately. This, however, is usually unnecessary, since the changing action of the extraocular muscles learned on the one eye for different positions of gaze may be readily applied to that for conjugate movements.

243 Charles Street.

GUARDED MUSCLE SCISSORS

JESSE M. LEVITT, M.D.,
BROOKLYN

To eliminate the possibility of cutting into the eyeball in surgical procedures on the extraocular muscles, guards were placed on a pair of Aebli muscle scissors. The points of the scissors were blunted with small spherical knobs. Elevator guards, 0.8 mm. high, 9.5 mm. long and 2.5 mm. wide, were placed on both blades halfway between the ball tips and the screw, as shown in the accompanying figure.[1] With the increasing amount of surgical work on the oblique muscles now being done, these guards add a special factor of safety. They are particularly useful in operations on the inferior oblique muscle, in which



Guarded muscle scissors.

there is danger of injury to the long ciliary nerve, the vortex veins and the macular area.

These scissors have proved useful in other ways. A uniform stump is left in muscle resections when the scissors are applied flush with the sclera. Sutures can be tied close when held taut without cutting the knots when the scissors are applied flush with the united muscle. The scissors have also been found helpful in enlargement of cataract incisions, affording easy entrance into the anterior chamber and limiting the extent to which the blade can be introduced.

991 Ocean Avenue (26).

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1. The instrument was made by V. Mueller & Co., Chicago.

News and Notes

EDITED BY DR. W. L. BENEDICT

GENERAL NEWS

Leslie Dana Award.—The National Society for the Prevention of Blindness, Inc., is pleased to announce that the Leslie Dana Gold Medal, awarded annually for outstanding achievements in the prevention of blindness and the conservation of vision, was presented to Dr. Frederick H. Verhoeff, of Boston. The medal was presented by Dr. Lawrence T. Post, of St. Louis, during the faculty luncheon of the American Academy of Ophthalmology and Otolaryngology, in Chicago, on Thursday, October 16. Dr. Verhoeff was selected for this honor by the St. Louis Society for the Blind, through which the medal is offered by Mr. Leslie Dana, of St. Louis. This highly prized token of recognition in the field of public health is given on the recommendation of the Association for Research in Ophthalmology, Inc.

Glaucoma Prize Offered by the International Association for Prevention of Blindness.—The office of the International Association for Prevention of Blindness announces an honorarium of $1,000 to promote research in ophthalmology is offered through the American members of the International Association, the judges to consist of the executive committee, the president and the officers of the association. The award will be made in connection with the Sixteenth Concilium Ophthalmologicum. Papers may be presented by any responsible research worker. The subject is "Simple Noninflammatory Glaucoma" and may include anything definitely related to the problem. The matter must be new and of such value, in the judgment of the jury, as to merit this recognition. Papers may be written in English or French, and they should be those heretofore unpublished or those published between the date of this announcement and Oct. 15, 1949. They should be in the hands of the secretary of the International Association for the Prevention of Blindness, 66 Boulevard Saint-Michel, Paris, through whom they will be sent to the members of the judicial committee, not later than Oct. 15, 1949. The decision of the judges will be final.

Schoenberg Memorial Award Lecture.—Dr. Peter C. Kronfeld, chief of the ophthalmic service of the Illinois Eye and Ear Infirmary, gave the first Mark J. Schoenberg Memorial Award lecture on Monday evening, Dec. 1, 1947, at the New York Academy of Medicine. His subject was "The Canal of Schlemm." Members of the committee to choose a lecturer each year in honor of the late Dr. Schoenberg are Isadore Givner, M.D., chairman; John N. Evans, M.D.; Willis S. Knighton, M.D.; Adolph Posner, M.D., and James W. Smith, M.D.

American Academy of Ophthalmology and Otolaryngology.—The annual meeting in 1948 will be held at the Palmer House, in Chicago, on October 10 to 15.

The Council for 1948 consists of the following officers: Carl H. McCaskey, M.D., Indianapolis, president; Conrad Berens, M.D., New

York, president-elect; Ralph O. Rychener, M.D., Memphis, Tenn., first vice president; Rea Ashley, M.D., San Francisco, second vice president; Ray K. Daily, M.D., Houston, Texas, third vice president; Lawrence T. Post, M.D., St. Louis, past president; Gordon B. New, M.D., Rochester, Minn., past president; Alan C. Woods, M.D., Baltimore, past president; William L. Benedict, M.D., Rochester, Minn., executive secretary-treasurer, editor and business manager of the *Transactions*; Algernon B. Reese, M.D., New York, secretary for ophthalmology; James H. Maxwell, M.D., Ann Arbor, Mich., secretary for otolaryngology; A. D. Ruedemann, M.D., Detroit, secretary for instruction in ophthalmology; Dean M. Lierle, M.D., Iowa City, secretary for instruction in otolaryngology and maxillofacial surgery; Lawrence R. Boies, M.D., Minneapolis, secretary for home study courses; Erling W. Hansen, M.D., Minneapolis, secretary for public relations; James M. Robb, M.D., Detroit, councillor; C. D. Blassingame, M.D., Memphis, Tenn., councillor; Thomas D. Allen, M.D., Chicago, councillor; Fletcher D. Woodward, M.D., Charlottesville, Va., councillor.

Dr. E. V. L. Brown to Lecture at Joint Meeting of Institute of Medicine of Chicago, Chicago Ophthalmological Society and Society of Medical History of Chicago.—The Institute of Medicine of Chicago announces that Dr. E. V. L. Brown, Rush Clinical Professor Emeritus in opthalmology, University of Illinois College of Medicine, delivered the first presentation under the gift of the Rudolph Wieser Holmes and Maria Baxter Holmes Fund, in memorial to Edward Lorenzo Holmes, at the Palmer House on Friday evening, January 30, at a joint meeting with the Chicago Ophthalmological Society and the Society of Medical History of Chicago. His subject was: "Edward L. Holmes: Pioneer Chicago Eye Doctor."

SOCIETY NEWS

New York Association for the Blind.—The New York Association for the Blind, 111 East Fifty-Ninth Street, New York 22, has sent the following program to ophthalmologists, medical workers and welfare agencies:

"For the person who is losing his sight, or who has just lost it, the knowledge that he can be trained to read and to write Braille, to work, to receive understanding guidance, and to enjoy himself through recreation and play, may change his whole outlook from despair to hope. from hope to realization.

"All of our services are free to the blind of all ages, races, and creeds, rich as well as poor, who are residents of Manhattan, Bronx, Queens and Richmond. Through training for selective placement, many persons without sight have demonstrated their ability to be successful in industry and have become self-supporting.

"We are especially interested in blind infants and children of preschool age, who are visited and supervised in their homes by our experienced medical social workers until they are ready for our Lighthouse Nursery School.

"We hope you will bring to our attention any totally blind child or adult or any individual with seriously defective vision, to whom we may offer our many services.—Marian Held, Director, Department of Direct Services."

Annual Congress of the Ophthalmological Society of the United Kingdom.—The annual congress of the Ophthalmological Society of the United Kingdom will be held at the Royal Society of Medicine, 1 Wimpole Street, London, W. 1, on Friday and Saturday, April 9 to 10, 1948.

The subject for discussion will be subjective disorders of vision, exclusive of those due to local ocular disease. The discussion will be opened by Dr. Macdonald Critchley, Prof. Henry Cohen and Mr. J. H. Doggart.

On this occasion the Bowman Lecture will be delivered by Prof. Marc Amsler, Zurich, Switzerland.

On Friday afternoon there will be a joint clinical meeting with the Ophthalmological Section of the Royal Society of Medicine at the Ophthalmic Institute, Central London Ophthalmic Hospital, Judd Street, London, W. C. 1.

The annual dinner will be held at the Royal College of Surgeons on Thursday, April 8.

Honorary secretaries are E. F. King (council business) and T. Keith Lyle (congress business).

Back Volumes of Transactions of the Ophthalmological Society of the United Kingdom.—The Ophthalmological Society of the United Kingdom holds a considerable stock of certain volumes of the *Transactions* since their first edition. The volumes for the following years however, are not available: 1897; 1898; 1899; 1900; 1901; 1902; 1905; 1906; 1907; 1908; 1909; 1911; 1917; 1918; 1919; 1920; 1921; 1922; 1923; 1924; 1926; 1927; 1928; 1929; 1930; 1931; 1932; 1933; 1934; 1935 and 1937 (part 1).

The council feels that many libraries, both at home and abroad, may wish to complete their sets and will be glad to present to libraries, medical schools and hospitals such available volumes as they may desire. No charge will be made other than the cost of postage.

Those interested are asked to communicate with the Bowman Librarian, Royal Society of Medicine, 1 Wimpole Street, London, W. 1.

Ophthalmological Society of Egypt.—The annual meeting of the Ophthalmological Society of Egypt will take place at the Memorial Ophthalmic Laboratory, Giza, Egypt, on Friday and Saturday, March 12 and 13, 1948, at 9 a. m. Medical practitioners, oculists and others are cordially invited.

Ophthalmological Society, Guadalajara, Mexico.—An ophthalmological society has been founded in Guadalajara, Mexico. Dr. Elias Mendoza Gonzalez is president and Dr. L. Nuñez Leal, secretary.

PERSONAL NEWS

Corneal Transplantation Discussed by Dr. A. E. Maumenee.—Dr. A. E. Maumenee recently discussed "Corneal Transplantation" for the members of the department of ophthalmology of the University of Alabama School of Medicine, at the Thigpen-Cater Eye Hospital.

Correspondence

CORRELATIONS BETWEEN SENSORY AND MOTOR DISTURBANCES IN CONVERGENT SQUINT

To the Editor:—The paper by Dr. Francis Heed Adler and F. Elizabeth Jackson published under this title in the September 1947 issue of the ARCHIVES is, in my opinion, an important step toward the clarification of the problem of retinal correspondence in squint. The data contained in the paper were derived from a large number of uniformly observed cases, and as to their validity there can be no question. Still, with the authors' tabulation and interpretation of their data at least one reader cannot fully agree.

In analyzing their cases, Adler and Jackson found that out of 175 cases of squint, normal correspondence was present in 64, or 35 per cent. The remaining 111 cases are tabulated under the heading "anomalous correspondence." This is regrettable, since to the superficial or uninitated reader it will convey the impression that the authors' data confirm the belief that anomalous correspondence is a common, typical, and therefore important, attribute of established comitant squint. In fact, they prove just the opposite.

The subdivision of the cases tabulated under "anomalous correspondence" into several types shows that in only 5 out of a total of 111 cases was there what is called "harmonious anomalous correspondence," the only type for which even the most ardent adherent of an empiricist theory of binocular correspondence could claim any purposiveness. Another 17 cases were labeled as "unharmonious." The overwhelming majority of the cases of squint tabulated under the heading "anomalous correspondence," viz., 89 out of 111, are described in the text as cases "without functional correspondence, since . . . no particular area is found to correspond directionally with the fixing macula."

A clearcut statement from such an eminent source, based on such irrefutable evidence as the authors have to offer, would have helped many a befuddled reader to make it finally clear to himself that even the vestige of a sensorial relationship between the two eyes (i. e., a directional relationship) is exceptional in cases without normal binocular correspondence. The tabulating of cases "without functional correspondence" under the general heading "anomalous correspondence," as the authors found it fit to do, will only confuse him more.

I realize that this is not the opportunity to unfold the whole question of so-called anomalous correspondence. While the discovery of an anomalous directional relationship between a squinter's eyes seemed to be a welcome piece of evidence for the adherents of a bygone empiricism, today few will accept Duke-Elder's statement that secondary correspondence, as he calls it, "may be capable of eliciting full stereoscopic vision." A number of authors, of whom probably Travers is the best known, have shown that actually an area of suppression is found in that region of the squinting retina which adherents of the empiricist theory adorned with the midleading term "false macula." The fact that

persons with transient exotropia have normal correspondence and good binocular vision while their eyes are straight but report an anomalous directional relationship whenever one eye is turned indicates that the latter is a musculosensory phenomenon rather than one of adaptation or a sign of any kind of binocular vision.

The conclusion that one certainly is justified in drawing from the data published in this paper should, in my opinion, be formulated as follows:

1. Persons with squint who have no normal correspondence only exceptionally show any anomalous binocular directional relationship (which may be adapted or not adapted to the angle of squint).

2. Their overwhelming majority is "without functional correspondence" whatever.

ARTHUR LINKSZ, M.D., New York.

6 East Seventy-Sixth Street (21).

To the Editor:—Dr. Linksz is quite correct in stating that we have tabulated 80 per cent of the patients who did not have normal correspondence but who had suppression under the heading of "anomalous correspondence." We are in agreement with Dr. Linksz that this is an unfortunate term to use for this group, but no better one has been agreed on and the subject is still extremely controversial. Lancaster, Harms, Travers and Burian all classify this group of patients with those in whom anomalous correspondence can be proved with the major amblyoscope. Swan, Linksz and others object to the definition of "anomalous correspondence" as a condition in which the fovea of one retina and an eccentric element of the other acquire a common visual direction, since such a functional relation can be demonstrated in so few patients with anomalous retinal correspondence.

In the 80 per cent of patients with suppression, there is no functionally corresponding point in the squinting eye with the fovea of the fixing eye. Unfortunately, one cannot say that these patients have no functional correspondence whatever, since Burian states that in virtually every case it can be shown with the double image test that such a relationship does exist. One can only be certain that this group of patients does not have normal correspondence. It seems to me best that they be retained in the group with so-called anomalous correspondence until some final agreement among our experts is attained.

FRANCIS HEED ADLER, M.D., Philadelphia.

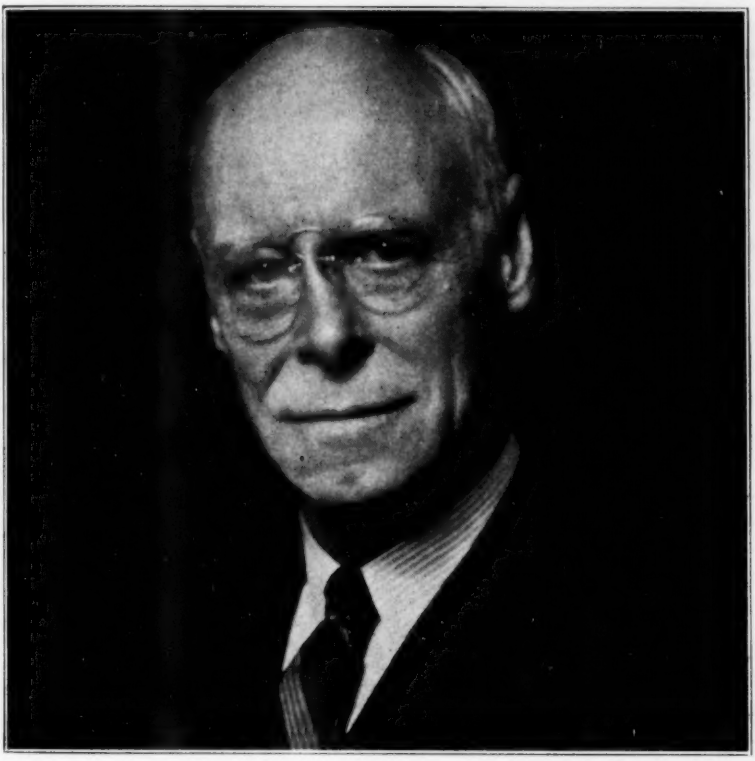
Hospital of the University of Pennsylvania.

Obituaries

LOUIS STORROW GREENE, M.D.

1872-1947

Louis Greene was born at Columbus, Ga., on Nov. 19, 1872, the youngest son of Col. William Spencer Greene and Anne Storrow Greene. After obtaining his early education in schools in Alabama and Virginia, he received the degree of Doctor of Medicine from the



LOUIS STORROW GREENE, M.D.
1872-1947

University of Virginia in 1895 and then acted as intern in the Charity Hospital, New York city. In 1897 he entered on the practice of ophthalmology in Washington, D. C., and was associated with the late Dr. William H. Wilmer for a number of years. He continued in active practice in Washington until his death, on Nov. 12, 1947.

Dr. Greene was one of the original members of the staff of the Episcopal Eye, Ear and Throat Hospital when it opened on April 8, 1897 and had acted as chief of the ophthalmic service for the past twenty years, where his ability as an organizer and his interest in clinical ophthalmology were outstanding.

He became a member of the American Ophthalmological Society in 1908 and was a faithful and regular attendant at all the meetings. serving on the council and becoming president in 1936. He was a member of the Washington, D. C., Ophthalmological Society and of the French Ophthalmological Society and was made a life member of the Medical Society of the District of Columbia in 1943. During World War I he was ophthalmologist to the National Medical Advisory Board and was chief of the District of Columbia's eye-examining service for draftees.

Dr. Greene married Louise Packword Burke on Jan. 7, 1903; a son, Julian Burke Greene, and a daughter, Ann Carter Greene, with Mrs. Greene, survive.

Lou Greene was a man of sterling qualities, and under a somewhat reticent exterior was hidden a kindly and strong personality. He was devoted to his work, to his family and to his host of friends, as he went quietly along his way, doing good wherever he was. It can truly be said of him that he was a gentleman of the old school. His genial smile, dry wit and wise counsel will remain as cherished memories to those of us who were privileged to be counted among his friends.

EVERETT L. GOAR, M.D.

SELIG HECHT, Ph.D.

1892-1947

All workers in vision will feel a deep sense of loss in the passing of Selig Hecht, who died suddenly on Sept. 18, 1947, at the age of 55. Hecht was the outstanding authority of his generation in the physiology of vision. The breadth and significance of his contributions to this field and his unequaled mastery of its literature made him for many years its recognized spokesman.

Selig Hecht was born in Glogow, Austria, on Feb. 8, 1892. He was brought to this country as a child and was educated in the public schools of New York City. After obtaining the degree of Bachelor of Science from the College of the City of New York in 1913, he entered Harvard for graduate training in biology. There he undertook research for the doctorate with G. H. Parker and received the degree of Doctor of Philosophy in 1917.

For the next four years Hecht worked as assistant professor of physiology in the Creighton University School of Medicine, Omaha. During this period he laid the foundations of much of his later research. In a series of quantitative studies on the physiology of light responses in the ascidian Ciona and the clam Mya, Hecht revealed what he concluded to be the essential features of all photoreceptor processes. He showed that these are in all cases constructed about pseudoreversible photochemical systems, in which some photosensitive pigment is destroyed by light and is simultaneously reformed by ordinary chemical reactions. In the breakdown of such a light-sensitive pigment to a steady state concentration. Hecht recognized the basis of light daptation; and in the resynthesis of this pigment in darkness he saw the source of dark adaptation. Hecht also at this time performed his classic experiments on the bleaching of rhodopsin in solution.

From 1921 to 1926, Selig Hecht was a National Research Council fellow in chemistry, working at the universities of Liverpool and Cambridge in England, at the Naples Zoological Station and at the Harvard Medical School. In 1926 he was called to the professorship of biophysics at Columbia University, and this post he retained until his death.

At Columbia Hecht devoted himself primarily to the study of human vision, and here his contribution is the most comprehensive since that of von Helmholtz. In rapid succession, he formulated simple, rational approaches to problems of human dark adaptation, intensity discrimination, visual acuity and the fusion of flickering lights. In 1930 he brought together what had been widely scattered and unorganized data

in a new theory of human color vision, the most original and provocative contribution to the subject in this century.

Most recently, Hecht had become interested in quantum relations of vision. In a brilliant analysis a few years ago, he showed that the minimal sensation of light can be excited by the absorption in the retinal rods of only 5 to 7 quanta of radiation. The circumstances

SELIG HECHT, PH.D.
1892-1947

surrounding this conclusion made it reasonably certain that a single rod can be stimulated by the absorption of 1 quantum. The consequences of this realization for the theory of vision are incalculable, and Hecht was in the midst of developing them further at the time of his death.

For his work in vision Hecht received the Frederick Ives Medal of the Optical Society of America in 1941. He was elected to mem-

bership in the National Academy of Sciences in 1944. During the war he served on the Subcommittee on Visual Problems of the National Research Council and on the Executive Committee of the Army-Navy Office of Scientific Research and Development Vision Committee. He directed visual research under a number of contracts with the military forces.

Hecht was a brilliant teacher and lecturer. He was selected as a national Sigma Xi lecturer in 1943. His intellectual interests carried his teaching activities far outside the field of vision. He enjoyed greatly giving a series of lecture courses on a variety of scientific subjects at the New School in New York City. His book "Explaining the Atom" (New York, the Viking Press, 1947) is widely recognized as among the best lay approaches to atomic structure and energy. Hecht was also honorary vice president of the Emergency Committee of Atomic Scientists, the only nonatomic scientist in this group.

Such a review as this of Hecht's accomplishments and activities conveys nothing, however, of the essential character of the man. He was one of the most striking and vivid personalities of his time, a man of deep cultivation, broad interests, deft wit and warm sympathy. He was interested in everything; his mind was never at rest. He was an accomplished painter, understood music as do few nonprofessional musicians, read widely and always well and enjoyed intensely everything he did. One could scarcely know him without being changed by the experience. In his death all scientists will recognize the passing of a great scientist; and they, and many others, will feel the loss of a warm friend.

GEORGE WALD.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Experimental Pathology

EXPERIMENTAL DINITROPHENOL CATARACT. J. W. BETTMAN, Am. J. Ophth. **29:** 1388 (Nov.) 1946.

Bettman summarizes his experiments and draws the following conclusions:

Dinitrophenol acts on the lenses of mammalian and avian species only in vivo.

Lenses in vitro did not form this opacity. This difference may be because (*a*) dinitrophenol, when in the anterior chamber, forms another compound, which then acts on the lens; (*b*) the permeability of the lens capsule is different when the lens is in vitro than when it is in its normal state, or (*c*) dinitrophenol interferes with some phase of metabolism of the living lens, for example, causing an increased need for oxygen or producing more lactic acid.

The failure of mammals to show the transient lenticular opacities observed in fowl is due to a difference in metabolism of the species, not to a difference in the lenses themselves.

The variations due to metabolism are confirmed by the occasional occurrence of permanent cataract in congenitally obese mice. Such opacities did not occur in nonobese mice. This frequency of cataract formation is comparable to the incidence of cataract in obese human beings and may explain the previous failures of numerous investigations to produce cataracts in experimental mammals.

The difference in incidence of cataract in fowl and in mammals is apparently not due to the difference in body temperature. The age of the animal is little, if at all, related.

W. S. REESE.

EFFECT OF OILY DROPS ON EYES EXPOSED TO MUSTARD VAPOR. G. I. UHDE and E. B. DUNPHY, Am. J. Ophth. **29:** 1562 (Dec.) 1946.

From experiments on rabbits, Uhde and Dunphy conclude that the current belief in the danger of using oily drops in the treatment of eyes exposed to mustard gas (2-chloroethyl sulfide) vapor is unfounded.

W. S. REESE.

General Diseases

THE MODERN CONCEPT OF THE ADIPOSOGENITAL SYNDROME. M. ALBEAUX-FERNET and G. LOUBLIE, Arch. d'opht. **6:** 257, 1946.

This paper is a review of this condition. The syndrome is as frequent in one sex as in the other and first manifests itself in childhood or adolescence, rarely in early adult life. The characteristics are described, and the diagnosis is reviewed from the point of view of

roentgenologic and ophthalmologic examinations. The authors point out that examination of the visual fields is the most important part of the ophthalmologic study and that a common finding is bitemporal hemianopsia, but that sometimes a homonymous hemianopsia may be present. Examination of the pupil is of little value. The clinical forms of the syndrome are described. In the pure state the condition is due to a chromophobic adenoma of the hypophysis or to a craniopharyngioma. The histologic work which has been reported is reviewed. The dystrophies are also considered in connection with this syndrome. A bibliography of the recent work is appended. S. B. MARLOW.

TWO CASES OF RETINITIS IN ACUTE INFECTIONS DURING CHEMOTHERAPY. B. NYQUIST, Acta ophth. **21**: 61, 1944.

Two cases of retinitis complicating chemotherapy are reported. A woman aged 52 had slight retinitis in one eye, together with jaundice and an exanthem, in the course of mild erysipelas, which was treated with a sulfonamide drug. The fundus was normal when the patient was seen again, four months later.

A woman aged 57 while undergoing treatment for pneumonia with sulfathiazole exhibited a dense macular exudate, together with hemorrhages, in both eyes. The lesions cleared in six months, but small residual central scotomas remained. The author is not sure whether these complications are related to the drugs or to the underlying disease process. O. P. PERKINS.

Glaucoma

THE PRODUCTION OF A FILTERING CICATRIX IN GLAUCOMA. RICHARD CRUISE, Brit. J. Ophth. **31**: 265 (Feb.) 1947.

Cruise obtained for microscopic examination an eye on which he had performed a successful hinged flap sclerotomy twelve years previously. Microscopic observations by E. Wolff substantiated the theory on which the operation was based—the establishment of permanent drainage from the anterior chamber by means of incisions alone, without excision of any tissue. The technic of the operation is as follows:

A flap of conjunctival and subconjunctival tissue is dissected down to the limbus, the cornea being split for 0.5 mm. A special hook with a very sharp point is inserted into the corneosclera just above the limbus, so as to get a firm hold of the eyeball. The anterior chamber is entered by dissecting through the sclera 1.5 mm. from the limbus with a scalpel or a Graefe knife for a distance of 5 mm. If the aqueous is permitted to escape slowly, the iris does not prolapse. If it does, it can be replaced with a repositor and there will be no tendency for protrusion of the iris when the posterior chamber is empty. While the corneoscleral lip of the incision is held with the hook, with a pair of sharp-pointed scissors two lateral cuts of 2 mm. are made, one at each end of the incision, and sloped toward each other, so as to make a blunt-angled hinge, with the apex directed toward the cornea. The conjunctiva is replaced but not sutured. If the conjunctival flap is thick, as it is in some cases in which there is plenty of subconjunctival tissue, a suture that merely keeps the flap from flopping forward may

be inserted, but never pulled tight, as this would tend to hasten healing. By this means an incision of 9 mm. has been made in endothelium-lined tissue, and it is the author's experience that this procedure is adequate to produce an endothelium-paved cicatrix, with minimal risk of prolapse of the iris. Primary union of the corneoscleral flap is prevented by massaging aqueous through the incision under the conjunctiva, the escaped aqueous causing the corneoscleral flap to ride up and delay approximation of its edges. This massage must be done within twenty-four hours and must be continued for a week or ten days; otherwise there will be a tendency to premature union of the edges of the incision. Primary union is delayed deliberately in order to enable endothelial cells to proliferate and insinuate themselves between the cut margins at the expense of the normal connective tissue cells and form a permeable track through the periphery of the anterior chamber. Microscopic study showed that the boggy area of filtration was covered with thinned conjunctival epithelium, containing two to four layers of nuclei. It was limited above by a characteristic papillary-like thickening of the epithelium. The drainage area was largely filled with a delicate spongework of connective tissue, with here and there some fine fibers, which stained like Descemet's membrane. The actual track in the corneosclera was filled with the same spongework of delicate connective tissue as was the drainage area. Here and there, also, were spots of pigment. The walls of the track were lined in part with definite endothelium, while in other parts the sclera was bare; in these parts the incision had apparently undergone no change since the day it was made, about twelve years ago. In many of the sections a portion of Descemet's membrane was seen, no doubt owing to the tendency of this membrane to curl forward when cut.

The author comments as follows: An endothelial lining of filtering scars is usually denied, but there can be no doubt of its presence here. The fact that the sclera has shown no signs of healing appears to bear out Thomson Henderson's theory that tissues bathed by the aqueous are not stimulated to show the usual signs of repair.

The article is illustrated.

W. ZENTMAYER.

Hygiene, Sociology, Education and History

ESERINE [PHYSOSTIGMINE]: ITS HISTORY IN THE PRACTICE OF OPHTHALMOLOGY. F. H. RODIN, Am. J. Ophth. **30:** 19 (Jan.) 1947.

Rodin gives an interesting account of physostigmine (eserine) starting with Daniell's description of the Calabar bean (Physostigma renenosum), or esère, as the natives of old Calabar (West Africa) called it, and which they used in their judicial procedures. If, after a predetermined period, the accused vomited this poison, he was considered vindicated and was freed of his charge. Robert Christison was the first to experiment with the Calabar bean, and he used himself as a subject. Thomas R. Fraser, his assistant, continued his study and isolated its active principle, physostigmine. Argyll Robertson also experimented with the drug and emphasized its miotic action, but Ludwig Laqueur was the first ophthalmologist to use it for glaucoma.

W. S. REESE.

Injuries

THE INTRAOCULAR FOREIGN BODY: A SERIES OF SEVENTY-TWO CASES IN THE B. L. A. H. B. STALLARD, Brit. J. Ophth. **31: 12** (Jan.) 1947.

An account is given of 72 cases of penetrating wounds of the eye with retained intraocular foreign body in which the patients came to a field hospital in Normandy and a 2,000 bed general hospital in Belgium (British Liberation Army) from July 1944 until the end of hostilities in Europe, in May 1945. Besides battle casualties, the cases represented accidental injuries in field workshops and injuries inflicted by foolish and negligent handling of military weapons. Methods of localization with roentgen rays and types of the giant electromagnet are discussed. It is pointed out that in military surgical procedures carried out under field conditions such apparatus has to be simple. The localization must be used expeditiously by men with no special knowledge or training. The average time for a case was three minutes for suturing a limbal ring in place, about ten minutes for the roentgenographic examination and seven to twelve minutes for the operation of extraction of the foreign body by the scleral route. Visual results at the time of evacuation ranged from 6/5 to no perception of light (2 cases). Two eyes were ultimately excised. The scleral route for extraction is indicated in the majority of cases and is simpler and less traumatic than the anterior route. With careful technic, the danger of loss of vitreous is negligible. This complication did not occur in this series. Retinal detachment is mentioned in the literature as a complication of the operation by the scleral route. This catastrophe is unlikely to occur as a direct result of the operation when diathermy has been used around the incision in the sclera and intraocular membranes. It may have happened in cases in which diathermy was not used, but there is no comment on this point in the literature. Retinal detachment is more likely to be due to the pathologic changes induced inside the eye at the time of injury. In this series, 69.3 per cent of foreign bodies were extracted, 51.3 per cent by the scleral route and 18 per cent by the anterior route. The article is lengthy and is a comprehensive survey of the entire subject of intraocular foreign bodies.

W. ZENTMAYER.

Lacrimal Apparatus

A SURVEY OF THE RESULTS OF LACRIMAL STRICTUROTOMY. I. LLOYD, Brit. J. Ophth. **31:51** (Jan.) 1947.

Lloyd has modified the French method of performing stricturotomy on the lacrimal passages. The canaliculus can be dilated sufficiently to allow the passage of the stricturotomy knife with a slight or negligible slit. Dilation was performed every two weeks for two months and then discontinued unless indicated by a return of symptoms. An analysis of 31 cases showed that mucocele was present in 4 cases; chronic low grade mucopurulent infection of the lacrimal passages in 12 cases, and bilateral obstruction in 10 cases. The effects of the operation were traced in 29 cases. Complete cure resulted in 15 cases (52 per cent)

and "improvement" in 7 cases. Symptomatic relief satisfactory to the patient was obtained in 76 per cent of cases. There were 7 failures.

W. ZENTMAYER.

Lens

PROLIFERATION OF THE EPITHELIUM OF THE LENS. B. SAMUELS, Am. J. Ophth. **30:** 1 (Jan.) 1947.

Samuels summarizes a study of the proliferation of epithelial cells of the lens in 185 cases of nontraumatic cataract. The lenses that showed the greatest proliferation were in the eyes with corneal scars, spontaneous iritis and detachment of the retina. These were the eyes in which a low grade, chronic alteration in the metabolism had existed over the longest period.

The lenses that showed the least proliferation belonged in the eyes with intraocular tumors and glaucoma. Death of the cells characterized the cases of tumor, owing to the irritant poisons eliminated by the tumor as it became necrotic. That multiplication of cells was seldom seen in the glaucomatous globes was probably due to the fact that the cells were compressed between the swollen lens substance and the distended capsule. This may be the reason that in cases of glaucoma an anterior polar cataract is a clinical rarity.

W. S. REESE.

STARS OF THE CRYSTALLINE LENS AND ARRANGEMENT OF ITS FIBERS: PERSONAL OBSERVATIONS. M. DRUAULT, Arch. d'opht. **6:** 16, 1946.

The embryonic development of the stars of the lens is reviewed. The author points out that the anterior Y is upright and the posterior one inverted. There is considerable variation in their exact positions, and the author presents a review of the studies which have been made in the literature, as well as his own. He calls attention to the fact that in the older observations the stars were located between the fetal nucleus and the cortical layers. With the slit lamp they have more recently been seen between the embryonic and the fetal nucleus.

S. B. MARLOW.

Neurology

CHANGES IN SENSORY ADAPTATION TIME AND AFTER-SENSATION WITH LESIONS OF PARIETAL LOBE. M. B. BENDER, Arch. Neurol. & Psychiat. **55:** 299 (April) 1946.

Bender summarizes his article as follows: "A patient with gunshot wound of the left posterior parietal and occipital lobes showed disturbances in visual, cutaneous and proprioceptive senses on the right side of his body. These defects were elicited under special conditions. Whereas with single stimulation his vision appeared to be intact, simultaneous stimulation of his right and left fields of vision caused the image on his right to become extinct. This phenomenon of extinction was found in various forms, from fluctuation and blurring to complete invisibility of an image. A similar phenomenon was found for cutaneous perception. . . .

"Another patient, with a gunshot wound in the left anterior parietal and posterior frontal lobes, showed motor and sensory disturbances in the right side of his body. The sensory changes could be elicited only under special conditions and were expressed as a prolongation of the periods of sensory adaptation and after-sensation. With paired equal stimulation, sensation was apparently enhanced on the affected side. With paired simultaneous stimulation in which a strong stimulus was applied to the left side and a weak stimulus to the right side, there was reduction of sensory adaptation time, and even extinction of sensation. This case illustrates the phenomenon of 'enhancement or extinction' of sensation, either of which could be obtained on stimulating the same area of skin at different times under different conditions. . . . These patients also showed decrease of increase in after-sensations.

"These observations reveal that most of the disturbances in these patients were due to normal mechanisms (such as rivalry with resultant dominance, sensory adaptation and after-sensations) which became apparent under pathologic conditions, such as lesions in the parietal lobe. Why these mechanisms became apparent is not clear. Without the foregoing considerations and special investigations of sensations, most of the symptoms could not be explained, because routine neurologic examination for sensation revealed an essentially normal status in both these patients."

S. R. IRVINE.

PHENOMENA OF SENSORY SUPPRESSION. N. REIDER, Arch. Neurol. & Psychiat. **55:** 583 (June) 1946.

"Clinical studies on suppression phenomenon are reported in which stimuli originating in a normal, or relatively normal, sensory field tended to inhibit or abolish the perception of stimuli arising from an 'affected' field.

"When this phenomenon involves vision, in the presence of normal visual acuity and normal perimetric fields, it may be mistaken for a post-traumatic neurotic reaction. The mechanisms underlying the pathophysiologic changes are discussed, emphasis being placed on the fact that the phenomenon may be elicited not only by contralateral but by homolateral stimuli. Theoretic implications of the phenomenon are mentioned."

These conclusions were derived from careful and detailed study of 2 cases of head injury, with subsequent continued visual complaints in 1 case and suppression of cutaneous sensation in the other.

S. R. IRVINE.

ABNORMAL DELAY OF VISUAL PERCEPTION. E. SACHS, Arch. Neurol. & Psychiat. **56:** 198 (Aug.) 1946.

The diagnostic method Sachs describes makes use of a peculiar visual phenomenon which makes possible recognition of minute unilateral delays in perception of visual impulses. Taking advantage of the high degree of sensitivity of visual reception, the method promotes recognition of the disturbed function of the optic nerve at an earlier stage than is obtainable with existing methods.

When a normal observer looks at a pendulum swinging in front of an illuminated background and a smoked glass is placed in front of one eye, the pendulum appears suddenly to describe a horizontal circle. This stereo-effect, the so-called Pulfrich effect, results from a lag of perception in the eye behind the smoked glass. The physiologic basis is probably slower conduction of impulses and/or transmission of the weaker of the two, otherwise identical, stimuli.

This normal Pulfrich effect is elicited by a brightness difference of certain magnitude between the illuminations of the two eyes. It is assumed that in persons with a pathologic condition of one optic nerve abnormal delay in conduction and/or transmission of impulses may be an early occurrence. This delay, however, at its early stage may be below the threshold of perceptibility, requiring a special "magnifying" device for demonstration.

The assumption is made that for persons with such subthreshold delay the light intensity for the eye on the affected side requires less reduction than for a normal observer in order to make the Pulfrich effect manifest.

A simple method of producing and measuring the Pulfrich effect by means of a moving rod and two pairs of polaroids is described.

Relations of the Pulfrich effect, static stereopsis and perception of movement and the site and cause of the abnormal Pulfrich effect are discussed; and the study of correlations between the abnormal effect and histopathologic changes is suggested. S. R. IRVINE.

RING SCOTOMA AND TUBULAR FIELDS: THEIR SIGNIFICANCE IN CASES OF HEAD INJURY. M. B. BENDER and H. L. TEUBER, Arch. Neurol. & Psychiat. **56:** 300 (Sept.) 1946.

After injury to the brain, apparent ring scotomas, concentric contraction of visual fields, shifting and "spiral" fields may be found with specific methods of examination of the fields. Different types of fields may be encountered in one and the same case. However, the changes observed vary consistently and directly with the different methods of plotting. The authors illustrate this in a case which was studied with neurologic, psychophysiologic and phenomenologic methods. The unusual field changes, viz., ring scotomas and contracted and spiral fields, as well as severe disturbances in visual perception (haziness, fragmentation and obliteration of images from the periphery inward), seemed to be produced by a continual fluctuation in the visual threshold for different parts of the field, with concomitant phenomena of extinction. It is concluded that such ring scotomas, despite their variability, are not psychogenic, but have an organic basis. S. R. IRVINE.

Operations

IMPLANTATION INTO TENON'S CAPSULE. S. A. FOX, Am. J. Ophth. **29:** 1571 (Dec.) 1946.

Fox describes a technic of implanting a plastic ball in Tenon's capsule after enucleation. He emphasizes the use of a snare to amputate the globe, and a conformer with a monocular dressing to prevent extrusion of the globe. W. S. REESE.

CONTRIBUTIONS TO TOTAL BLEPHAROPLASTY. I. CZUKRÁSZ, Brit. J. Ophth. **31:** 108 (Feb.) 1947.

Czukrász describes 3 cases in which three different methods of substituting for a total lack of eyelids were employed. The first procedure employed was that of Hughes, which is adapted to restore the upper and the lower lid. Blaskovic's second operation is suitable when the whole upper lid is missing. The Hungarian plastic procedure generally is used for substituting the lower lid only, but in cases in which both lids are missing the author recommends the sliding flap; moreover, if one hopes to save the bulb, the method offers the advantage of being able to replace at once the upper and the lower lid with one plastic arch.

The article is illustrated.

W. ZENTMAYER.

TECHNIC OF GRAFTING THE HUMAN CORNEA. G.-P. SOURDILLE, Arch. d'opht. **6:** 273, 1946.

The author describes his technic of grafting the cornea. One of the most important points is the use of a spatula designed to protect the lens while removing a piece of the cornea by trephining. The author is convinced that, in spite of many accidents, a good result is possible.

S. B. MARLOW.

Orbit, Eyeball and Accessory Sinuses

REMOVAL OF THE WRONG EYE. H. M. TRAQUAIR, Brit. J. Ophth. **31:**8 (Jan.) 1947.

The most terrible disaster which can occur to the ophthalmic surgeon and to the patient is "removal of the wrong eye." It might be thought that this accident is merely a possible, but unlikely, danger, about which teachers should warn students but which has never actually occurred. There is, nevertheless, abundant evidence that this catastrophe has actually occurred. The earliest reference to the matter which the author found was that of Mauthner, who wrote in 1881 that he had been present when the mistake was nearly made in a case of sympathetic ophthalmia. A quotation from Elschnig indicates that a case had occurred within his knowledge. The author states that of over 60 textbooks on ophthalmology and ophthalmic surgery published prior to 1898 examination of 37 available revealed mention of the subject in only 1. Only 4 of 14 books published since 1898 and 2 later editions of older work (Lawson and Czermak) contain such references. Recent works do not mention the subject; Sattler (von Graefe, F., and Saemisch, T., Handbuch der gesamten Augenheilkunde, Leipzig, W. Engelmann, 1922 [Sattler]) appears to give the latest reference. Of 8 direct references, only 1 is British, the rest being German and American. The diseases concerned, in actual instances, have been intraocular tumor, glaucoma and sympathetic ophthalmia, probably chiefly the first. Nothing is known as to even the approximate number of cases. As might be expected, in every known case a general anesthetic was used. In operations on infants and young children the risk must be taken, and it is the duty of the surgeon to take proper precautions personally, and not to delegate such an important

responsibility. The eye should be examined immediately before the operation, while the patient is on the table. If a general anesthetic is to be given either to an adult or to a child, administration should not be commenced until the surgeon is present.

The only infallible preventive, if any measure can be infallible, is the use of local analgesia. This method should be adopted in all cases of adults in which the eye to be removed does not obviously and distinctly differ in external appearance from the other. A paragraph on this subject should be included in every textbook in which removal of the eye is mentioned.

W. ZENTMAYER.

Physiology

FUNCTION OF THE PIGMENTED EPITHELIUM AND THE NEUROEPITHELIAL LAYERS OF THE RETINA. L. MAGGIORE, Ann. d'ottal. e clin. ocul. **72**: 1, 1946.

The author considers the behavior of visual function in cases of detachment of the retina. He shows that the light sense is in many cases partially reestablished after surgical intervention because of the rapidity with which the subretinal fluid is eliminated, together with some unknown behavior of the layer of rods and cones and the pigmented epithelium. On the basis of his previous investigations on the persistence of certain visual functions in cases of partially detached or incompletely reattached retina, he formulates the following hypothesis: Since the subretinal fluid layer is rather thin, the electrons liberated by the effects of light on the pigment cells (Schanz's theory) can influence the behavior of the rods and cones. It follows that the classic concept of the need for intimate contact between the neuroepithelial and the pigmented epithelial layer is of value only when perfect visual function is intended. A partial retinal function is, in fact, possible within certain limitations.

G. B. BIETTI.

Retina and Optic Nerve

POSTNEURITIC OPTIC ATROPHY IN REPATRIATED PRISONERS OF WAR. W. L. ROBERTS and T. H. WILLCOCKSON, Am. J. Ophth. **30**: 165 (Feb.) 1947.

Roberts and Willcockson report 6 cases of visual impairment of nutritional origin, in none of which did any improvement result from intensive dietary therapy. In all but 1 case there was a history of beriberi or pellagra, and in all the patients had suffered severe malnutrition with serious loss of weight. In all but 1 case the fields showed bilateral absolute central or paracentral scotoma, but the peripheral fields were constricted in only 2 cases.

W. S. REESE.

NUTRITIONAL RETROBULBAR NEURITIS. F. D. CARROLL, Am. J. Ophth. **30**: 172 (Feb.) 1947.

Carroll refers to and discusses Whitbourne's work in Jamaica, West Indies, and his own observations on former Japanese prisoners at the Valley Forge Hospital and concludes that the syndromes in the two

groups are similar. He reports the case of a man aged 24 who had lived in Jamaica all his life. Vision was 20/200 in each eye, and the patient had dense centrocecal scotomas. W. S. REESE.

CONCENTRIC BODIES IN THE SHEATH OF THE OPTIC NERVE: THEIR SIGNIFICANCE AND CLINICAL INTEREST. G. OFFRET, Arch. d'opht. 6: 29, 1946.

In this article, the author refers to the corpora amylacea. He reviews their histologic character and presents photomicrographs of these bodies. He calls attention to their location in the sheath of the optic nerve and the arachnoid of the brain. From his studies, he concludes that these bodies are derived from the meningoblast. They are observed in the adult in the depths of the dura and are sometimes calcified. They are histologically similar to the bodies present in the meninges of the brain and in meningoblastomas. A number of photomicrographs illustrating the points which the author makes are presented. S. B. MARLOW.

Tumors

INHERITANCE OF RETINOBLASTOMA: TWO FAMILIES SUPPLYING EVIDENCE. H. F. FALLS, J. A. M. A. 133: 171 (Jan. 18) 1947.

Two new pedigrees are presented which lend support to evidence that retinoblastoma is a hereditary form of neoplasia. The first case was that of a girl aged 6 months. The diagnosis was bilateral retinoblastoma. There was minimal intraocular calcification in both eyes. Enucleation of the right eye was advised for pathologic study. The parents refused consent. In a twin sister, seen at the age of 11 months, a bilateral gray reflex had been observed at the age of 6 months. The diagnosis was bilateral retinoblastoma. Bilateral enucleation or roentgenotherapy was advised but consent was refused. In the first child spontaneous rupture of the globe occurred at the age of 9 months. The second child died at the age of 13 months of reported intracranial and posterior orbital extension. The first child wasted away in cachexia. There was intracranial and posterior orbital extension.

In the second family a girl aged 3½ years had the left eye removed for retinoblastoma. The history revealed that ocular tumors were common in the sibship of the child's mother. The mother had her left eye removed for retinoblastoma at the age of 3½ years. Five of the 9 siblings had a condition diagnosed as retinoblastoma. Two of those affected survived to reach child-bearing age.

The author summarizes his observations as follows: A family was observed in which retinoblastoma occurred bilaterally in identical female twins. In a second family both the horizontal and the vertical occurrence of retinoblastoma was observed. Retinoblastoma may have different genotypes, and it is not necessary to interpret all pedigrees in terms of a single mechanism of inheritance. Parents who have produced a child with retinoblastoma should be urged to discontinue having children, and children surviving enucleation for retinoblastoma should be sterilized.

W. ZENTMAYER.

Uvea

UVEITIS AND NICOLAS-FAVRE-DURAND DISEASE [LYMPHOGRANULOMA VENEREUM]. C. GARBINO, Arch. de oftal. de Buenos Aires 21: 88 (April-June) 1946.

The case histories of 4 patients with uveitis of an unknown cause are given. In all 4 cases the Frei test gave a positive reaction. Treatment with antimony and potassium tartrate gave excellent results. The author believes that in all cases of uveitis of unknown origin a Frei test should be made.

M. E. ALVARO.

PENICILLIN THERAPY: BILATERAL ENDOGENOUS UVEITIS. R. LACHMAN and E. P. CHACÓN, Arch. de oftal. de Buenos Aires 21: 94 (April-June) 1946.

A complete cure, with recovery of vision in both eyes within a short time, in a case of severe bilateral endogenous uveitis with hypopyon and low tension was obtained with penicillin. An initial dose of 20,000 units of penicillin was administered, with 15,000 units every three hours thereafter; 120,000 units were administered daily for eight days. At that time the authors again examined the patient. Vision was 10/10 in each eye. Corneal precipitates and slight pigment were present on the anterior capsule of the lens. The iris was normal. No other lesions were noted biomicroscopically.

M. E. ALVARO.

IRIDOCYCLITIS AND INFECTED VARICOSE ULCER. O. SILVEIRA, Ophthalmos 3: 3, 1944.

From the case observed, it is believed that there was a correlation between the iridocyclitis and the infected varicose ulcer, because the ocular disease proved incurable until the veins which formed the ulcer, also incurable, were excised; the iridocyclitis and the varicose ulcer were cured without other treatment.

M. E. ALVARO.

Vision

THE MIDDLE EAST ADAPTOMETER. W. H. WILSON, Brit. J. Ophth. 30: 645 (Nov.) 1946.

Wilson describes in minute detail the construction of an adaptometer devised for the army medical service in the Middle East. The primary purpose of the apparatus was to test the limits of dark adaptation in the considerable number of men complaining of night blindness and later to determine whether the night vision of men on special duties, such as night driving, was sufficiently good.

W. ZENTMAYER.

Book Reviews

Alterations de la rétine en rapport avec les affections générales. Atlas ophthalmoscopique II. By Paul Bonnet. Pp. 253, with 36 plates in color. Paris: Masson & Cie, 1947.

This report on retinal disorders related to systemic diseases was presented to the *Societé française d'ophthalmologie* on May 15 1947, and is the work of Paul Bonnet, professor at the ophthalmic clinic in Lyons. This is part 2 of the ophthalmoscopic atlas, of which part 1, on diseases of the retina, by Gabriel Renard, was published in 1946 and previously reviewed in the ARCHIVES (**38:** 129 [July] 1947).

The general diseases studied in this book are those of the blood. The retinal conditions enumerated are cyanosis of the retina, intracranial aneurysm, various types of leukemia, malignant Hodgkin's disease (lymphogranulomatosis), anemias, angiomatosis (Rendu-Osler disease), hemolytic jaundice, Banti's syndrome (splenomegaly of undetermined origin), hemorrhagic diathesis, the effects of thorium X, general infections and certain forms of diabetes. The discussion of each condition is prefaced by a short introduction on the fundamental medical illness, followed by a description of the ophthalmoscopic picture and its diagnosis. Illustrative case histories give the complete medical findings and the particular ophthalmoscopic picture, with an interesting discussion on its semiologic importance and comments on the information that the often neglected examination of the eye would give to the internist. In addition to the 47 drawings in the text, there are 36 plates in color, which illustrate the lesions described in the text and are the important part of the volume. The colored illustrations are well drawn and quite up to the high standard of reports of the French society. They are the work of the *Societé de photo-chromo-gravure of Lyons.*

This volume brings many interesting and unusual ophthalmoscopic pictures, particularly that of leukemia. It should be of value to the internist as well as to the ophthalmologist, and illustrates the closer relation which is developing between ophthalmology and internal medicine.

Dr. Bonnet has made a valuable contribution with this study, which has been carried on over a number of years, and the French Society of Ophthalmology deserves the gratitude of all ophthalmologists for its publication.

ARNOLD KNAPP.

Clinical Methods of Neuro-Ophthalmologic Examination. By Alfred Kestenbaum, M.D. Price, $6.75. Pp. 384, with 64 illustrations. New York: Grune & Stratton, Inc., 1946.

This book presents the methods of neuro-ophthalmologic examination which are essential for diagnosis in neurology and represents the author's twenty-five years of clinical work in neurologic services. Though the methods of neuro-ophthalmologic examination have gained by the introduction of more precise methods, owing to the conditions frequently

present, the simplest methods often have to be relied on. The book occupies, as the author says, a kind of intermediate position and aims to be a supplement to the larger books on neurology of the eye. The necessary anatomic data have been schematized, and certain groups of diseases which affect both the central nervous system and the eye have been omitted. General schematic rules are suggested as a help to the physician in arriving at a diagnosis. The findings indicated, in brief, are of value only when taken in combination with other signs and symptoms.

The book begins with a description of the anatomy of the optic pathways and of the field of vision and its defects. The author then takes up diseases of the optic nerve, chiasmic and retrochiasmic lesions, palsies of the ocular muscles, gaze movement and gaze palsy, nystagmus, disturbance of symmetric movement of the eyes, the disturbances of the palpebral fissure and functional disturbances. A short chapter is given over to the description of the routine neuro-ophahtlmologic examination. A glossary, a bibliography and an index conclude the volume.

In this book the neurologist will find a description of ophthalmologic methods of diagnosis, and the ophthalmologist will welcome the aid in arriving at a solution of the neurologic problems which he finds so difficult, even though the material is by no means easy reading. The book contains an enormous amount of information, which should be of great value and can be warmly recommended to those for whom it was written.

ARNOLD KNAPP.

Oculus: The Eye. Edited by K. Steindorff † and F. P. Fischer, Utrecht, Netherlands; J. S. Friedenwald, Baltimore, and Arnold Sorsby, London. Tabulae biologicae, volume 23. Price, 70 Dutch gulden. Pp. 412, with 11 plates and 87 figures. Dr. W. Junk, Amsterdam, Netherlands, 1947.

Part 1, on anatomic data, contains the following articles: Das Auge der Wirbellosen, H. Kahmann, Munich, Germany; Metrische und deskriptive Markmale des menschliche und tierischen Auges, S. Oppenheim, Utrecht, Netherlands; Embryologie de l'oeil des vertébrés, C. Dejean and F. Granel, Montpellier, France; La pupille des vertébrés, J. Nordmann, Strasbourg, France; Deskriptive Anatomie des Auges der Wirbeltiere und des Menschen, K. Steindorff, Milan, Italy; Der intraokuläre Druck, Der Augengefässdruck, K. W. Ascher, Prague, Czechoslovakia, and Cincinnati.

Parts 2, 3 and 4, which will cover chemical and physiologic data, are in press and will be published as soon as possible.

† Deceased.

ARNOLD KNAPP.

Gifford's Textbook of Ophthalmology. Revised by Francis H. Adler, M.D. Fourth edition. Price, $6. Pp. 512, with 310 illustrations. Philadelphia: W. B. Saunders Company, 1947.

In this revision of Gifford's textbook, Dr. Adler has been guided by the original purpose of the book to make it suitable for the medical student and for the general practitioner. As instruction in the fundamentals is essential, the author has given a more complete discussion

of the subject of the visual field, and there is a new chapter on "Disturbances of Ocular Motility," written from a physiologic approach. Consideration of orthoptics and operations on the ocular muscles has been omitted. The discussion of refraction is condensed. New chapters treating "Ocular Disorders Due to Diseases of the Central Nervous System" and "Ocular Manifestations of General Diseases" will be found interesting and will appeal particularly to the general practitioner. The discussion of operative treatment is limited to a short chapter.

While the book in its present form, with the revisions and additions just enumerated, seems greatly changed, much has been retained of its former character. Some of the additions appear to the reviewer as rather advanced for the average medical student and the general practitioner, but their worth may come in the later years of practice.

This book in its new edition should continue to hold its popularity with the medical public and serve as an excellent introduction to the study of ophthalmology.

ARNOLD KNAPP.

Contact Lenses. By Theo. E. Obrig. Second Edition. Price, $8. Pp. 560, with 204 illustrations. New York: Obrig Laboratories, Inc., 1947.

This is the second edition of Obrig's classic work, the first edition of which has already been reviewed in these ARCHIVES (**28**: 564 [Sept.] 1942). The statements then made still apply, but certain additions can be found in this edition. For example, new methods of molding are discussed, and the author's present technic is carefully described. He illustrates each device and procedure—casting shells, preparing the patient, making the mold and cast and duplicates of castings—by means of photographs, some of them new, and all of them excellent. Other additions include a new positive system of fitting, new information on solutions and a chapter on plastics. The bibliography has been brought up to 1946.

So far as the reviewer knows, this is the definitive textbook on contact glasses. Indeed, he knows of no other publication on the subject that approaches the compass of this scholarly work.

G. M. BRUCE.

Diseases of Children's Eyes. By James Hamilton Doggart, M.A., M.D. (Cantab.), F.R.C.S. Price, $10. Pp. 288, with 210 illustrations, including 32 color plates. St. Louis: C. V. Mosby Company, 1947.

From time to time attempts have been made to treat in print the problems of ophthalmology in its relation to children. The project has been undertaken in textbook form (Peters, A.: Die Erkrankungen des Auges im Kindesalter, Bonn, F. Cohen, 1910) and by means of contributions to the so-called medical systems (Doyne, P. G.: Diseases of the Eyes, in Thursfield, H., and Paterson, D.: Diseases of Children, London, Edward Arnold & Co., 1934, pp. 1086-1093. Terrien, F.: Maladies de l'oeil et de ses annexes, in Traité de médicine des enfants Nobécourt, P., and Babonneix, L.: Paris, Masson & Cie, 1934, vol. 4, pp. 805-837). Nowhere have these efforts been notably successful, for there is no essential difference between adult and infantile ophthalmic

disease. True, there are minor anatomic differences; but if one eliminates hereditary defects (which, after all, usually continue into adult life), diseases of the eye that attack children and children only are few and far between. Moreover, most ocular lesions, with but few pertinent exceptions, run in children a course identical with that observed in adults. Faced with these unavoidable difficulties, an author has but one recourse—he must write a general textbook in which he points out from time to time the peculiarities of each disease when it attacks children. This is precisely what Dr. Doggart has done; and he has done it so well that this volume, as it stands, would make an excellent textbook on ophthalmology. He points out that the ophthalmologist who undertakes the care of a child has to depend on a second-hand history, and cannot carry out subjective tests and elaborate methods of examination. Methods of overcoming these basic defects are mentioned from time to time, and the rest of the book is standard textbook material. There is included a chapter on "Ocular Welfare," but a similar discussion is to be found in some other textbooks, notably that of Parsons.

The illustrations are excellent, but familiar. I believe that I have seen nearly all of them elsewhere.

In general, this book will appeal chiefly to residents in ophthalmology and young ophthalmologists. Some of the chapters will be of interest to general practitioners and pediatricians.

G. M. BRUCE.

Office Treatment of the Eye. By Elias Selinger, M.D. Price, $7.75. Pp. 542, with 67 illustrations. Chicago: The Year Book Publishers, Inc., 1947.

This book is probably the most complete volume on ocular therapy that has appeared in recent years. It is a large book; yet it is well organized, with an excellent index, so that it should make a convenient reference text. While the material presented is largely the viewpoint of the author, the great majority of his ideas are orthodox and represent standard procedures that are generally accepted.

One of the important features of this book is the minute detail with which simple procedures, such as the removal of a conjunctival foreign body, are described. The careful presentation of fundamentals should make it of particular value to the beginner in ophthalmology. There is also such a wealth of material, obviously drawn from vast experience, that even the older practitioner should find much of interest and value.

Of course, no one will agree with everything in this book. Many will feel that the author has included much material that does not properly belong within the limits of office practice. Some may criticize him for attempting to include a discussion of refraction, which must of necessity be incomplete. To this reviewer, none of these criticisms is important, as they are completely outweighed by the vast amount of valuable material in the book.

There is no doubt that the author of this book has had a rich experience in the practice of ophthalmology, extending over many years. That he has had the ability to record this experience in a highly readable form and the patience to put down the most minute details make it an accomplishment of high order.

MAYNARD WHEELER.

The 1947 Year Book of Eye, Nose and Throat. Edited by Louis Bothman, M.D., and Samuel J. Crowe, M.D. Price, $3.75. Pp. 487, with 43 illustrations. Chicago: The Year Book Publishers, Inc., 1947.

This Year Book, in a compact and handy manner, contains an accurate review of the previous year's publications in ophthalmology, with an excellent index to subject matter and authors. The abstracts are well chosen, and in presenting the special topic, "Suggestions for Accurate Records in Ophthalmology," the author of the section on the eye, Dr. Louis Bothman, brings Elschnig's classification of normal optic disks and the method of recording lesions of the fundus, as described in Dr. Alfred Kestenbaum's book entitled "Clinical Methods of Neuro-Ophthalmologic Examination." The comments by the author are set forth clearly and are well worth reading. The part on the eye occupies 222 pages, and under the heading "General and Miscellaneous" are brought a number of important abstracts, of which may be mentioned "Vascular Basis of Allergy of Eye and Its Adnexa," "Ocular Toxoplasmosis," "Pigmented Tumors" and "Congenital Encephalo-Ophthalmic Dysplasia."

The book maintains the high standard previously established and will be found useful for its practical approach by all ophthalmologists.

ARNOLD KNAPP.

Relation of Diseases of the Eye to Diseases of the Nose and Sinuses (Published in Spanish). By Dr. Adolfo Gutmann. Pp. 40. San Antonio, Chile, Librería Nacimiento, 1947.

The author, formerly of Berlin, stresses the importance of diseases of the nose and sinuses in the causation of diseases of the extraocular structures. Besides the direct spread of diseases of the nose to the eye, chronic conditions can produce a sensorial or a vasomotor reflex in the eye and give rise to neuralgias and chronic edema of the lids and orbital tissues.

Sinusitis may result in the spread of an acute infection to the orbit and lead to exophthalmos and displacement of the globe by the formation of a mucocele. Infections of the posterior ethmoid cells and of the sphenoid sinus can cause peripheral contraction of the visual fields and central scotoma. In cases of central scotoma in which the blood, spinal fluid and nervous system are normal and no clearcut infection of the sinuses is found, opening the posterior ethmoid cells and the sphenoid sinus may improve the scotoma.

In cases of exophthalmos help in differential diagnosis is obtained by use of the piesimeter. This instrument is much like a tonometer and is graduated on a scale of 0.1 mm. It is applied to the cornea and a weight of 25 Gm. added. In a case of edema of the orbit the globe is pushed back; this does not happen when a solid mass is the cause of the exophthalmos. Both eyes must be measured and the results compared. In the normal eye the reading average is 1.1 mm. In a case of exophthalmos due to edema of the orbital tissues the globe can be pushed farther back into the orbit than in the case of a solid orbital tumor; in the latter it may not be possible to push back the globe at all.

HUMBERTO ESCAPINI.

Ophthalmology: Section XII of Excerpta Medica. Amsterdam, Netherlands: N V Excerpta Medica, 1947.

Excerpta Medica is a monthly journal, published in English, of the world's medical literature, comprising fifteen sections and covering the whole field of theoretic and clinical medicine.

The *Excerpta* is under the general editorship of M. W. Woerdeman, chairman, professor of anatomy in the University of Amsterdam; A. P. de Kleyn, professor of otolaryngology, and W. P. Zeeman, professor of ophthalmology, also of the University of Amsterdam. The board of editors for section XII, which is devoted to ophthalmology, is composed of ophthalmologists from all over the world, including nine from the United States. The subeditor is Dr. J. E. Winkelman, of Amsterdam. The first three issues of volume I, section XII, are now published and are an outstanding contribution to ophthalmic literature. The editors have set themselves a number of objectives, which seem to have been well lived up to in the first three issues. Completeness is the first objective, and the aim is to abstract every available article on ophthalmology appearing in the medical literature of the world. The length of the abstract varies from merely a mention by title to one sufficiently elaborated to allow the reader to judge for himself the importance of the original article and the basis for the author's statements.

Each issue is divided into eleven sections, as follows: (1) textbooks, manuals and monographs; (2) the history of ophthalmology—ophthalmology in its relation to the visual arts; (3) anatomy, embryology and ontogenetic development of the visual apparatus; (4) general and experimental physiology and pathology of the eye; (5) methods of examination; (6) hygiene and social medicine as they apply to ophthalmology; (7) special clinical ophthalmology; (8) therapeutics and pharmacology; (9) surgery; (10) comparative ophthalmology; (11) miscellaneous.

The type and paper are excellent, and, what is even more important, the English used is good. This is a welcome addition to the abstracting services already available in our journals, and Dr. Zeeman and his co-editors are to be congratulated on having done ophthalmology a splendid service.

Subscriptions can be obtained by writing to the agent for *Excerpta Medica* in the United States, namely, the Williams & Wilkins Company, Mount Royal and Guilford Avenues, Baltimore 2. For Section XII the subscription rate is $15 per year.

FRANCIS HEED ADLER.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Dr. P. Bailliart, 66 Boulevard Saint-Michel, Paris, 6e, France.
Secretary-General: Dr. A. Churchill, 66 Boulevard Saint-Michel, Paris, 6e, France.
All correspondence should be addressed to the Secretariat, 66 Boulevard Saint-Michel, Paris, 6e, France.

International Council of Ophthalmology

President: Prof. F. W. Nordenson, 3 Grefgatan, Stockholm, Sweden.
Secretary: Dr. Holger Ehlers, 4 Fernbanegade, Copenhagen, Denmark.

International Organization Against Trachoma

President: Dr. A. F. MacCallan, 17 Horseferry Rd., London S. W., England.

Pan-American Association of Ophthalmology

President: Dr. Harry S. Gradle, 14060 Valley Vista Blvd., Sherman Oaks, Calif.
Executive Secretaries: Dr. Conrad Berens, 301 E. 14th St., New York 3. Dr. M. E. Alvaro, 1151 Rua Consolacão, São Paulo, Brazil.
Place: Habana, Cuba. Time: Jan. 10, 1948.

FOREIGN

All-India Ophthalmological Society

President: Dr. E. V. Srinivasan, Mylapore, Madras.
Secretary: Dr. G. Zachariah, 16 Marshall's Rd., Egmore, Madras.

Belgian Ophthalmologic Society

President: Dr. L. Weekers, rue Forgeur 15, Liége.
Secretary-General: Dr. M. Appelmans, Avenue Ruelens 179, Louvain.

British Medical Association, Section on Ophthalmology

President: Dr. W. Clark Souter, 9 Albyn Pl., Aberdeen, Scotland.
Secretary: Dr. Frederick Ridley, 12 Wimpole St., London, W. 1.

Chengtu Ophthalmological Society

President: Dr. Eugene Chan.
Secretary: Dr. D. S. Shen, Eye, Ear, Nose and Throat Hospital, Chengtu, Szechuan, China.
Place: Eye, Ear, Nose and Throat Hospital, Chengtu, Szechuan, China.

Chinese Ophthalmology Society

President: Dr. C. H. Chou, 363 Avenue Haig, Shanghai.
Secretary: Dr. F. S. Tsang, 221 Foochow Rd. Shanghai.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and keep it up to date.

Faculty of Ophthalmologists

President: Sir Stewart Duke-Elder, 63 Harley St., London, W. 1, England.
Secretary: Mr. Frank W. Law, 45 Lincoln's Inn Fields, London, W. C. 2, England.

German Ophthalmological Society

President: Prof. W. Lohlein, Berlin.
Secretary: Prof. E. Engelking, Heidelberg.

Hungarian Ophthalmological Society

President: Prof. G. Horay, Budapest.
Assistant Secretary: Dr. Stephen de Grósz, University Eye Hospital, No. 1, Illesucca 15, Budapest.
All correspondence should be addressed to the Assistant Secretary.

Midland Ophthalmological Society

President: Mr. Charles Rudd, 91 Cornwall St., Birmingham 3, England.
Secretary: Mr. P. Sameson Evans, 51 Calthorpe Rd., Birmingham 3, England.
Place: Birmingham and Midland Eye Hospital.

North of England Ophthalmological Society

President: Mr. O. M. Duthie, 22 St. John St., Manchester.
Secretary: Mr. William M. Muirhead, 70 Upper Hanover St., Sheffield 3.
Place: Manchester, Leeds, Newcastle-upon-Tyne, Liverpool, Sheffield and Bradford, in rotation. Time: October to May.

Ophthalmological Society of Australia

President: Dr. Claude Morfet, St. George's Terrace, Perth, Western Australia.
Secretary: Dr. Arnold L. Lance, 135 Macquarie St., Sydney.
Place: Perth, Western Australia. Time: Aug. 15-21, 1948.

Ophthalmological Society of Egypt

President: Prof. Dr. Mahmoud Lutfi, Ophthalmic Hospital, Giza.
Secretary: Dr. Mohammed Abbas El Bakly, Ministry of Public Health, Cairo.
All correspondence should be addressed to the secretary, Dr. Mohammed Khalil.

Ophthalmological Society of Hospital de Nuestra Señora de la Luz

Chairman: Dr. Manuel J. Icaza y Dublán, Artes 72, México, D. F., Mexico.
Secretary: Dr. Jorge Meyrán, Ezequiel Montes 135, México, D. F., Mexico.
Place: Hospital de Nuestras Señora de la Luz. Time: Second Friday of each month.

Ophthalmological Society of New Zealand

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Secretary: Dr. W. J. Hope-Robertson, Kelvin Chambers, 16 The Terrace, Wellington.

Ophthalmological Society of South Africa

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Secretary: Dr. J. K. de Kock, Groote Kerk Bldg., 32 Parliament St., Cape Town.

Ophthalmological Society of the United Kingdom

President: Dr. A. J. Ballantyne, 11 Sandyford Pl., W., Glasgow C. 3, Scotland.
Secretary: Mr. J. H. Doggart, 49 Wimpole St., London, W. 1.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Rd., Bombay 4, India.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14, India.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Oxford Ophthalmological Congress

Master: Mr. F. A. Williamson-Noble, 27 Harley St., London W. 1, England.
Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford. Time: July 3-5, 1947.

Palestine Ophthalmological Society

President: Dr. Arieh Feigenbaum, Abyssinian St. 15, Jerusalem.
Secretary: Dr. E. Sinai, Tel Aviv.

Philippine Ophthalmological and Otolaryngological Society

President: Dr. Antonio S. Fernando, Philippine General Hospital, Manila.
Secretary-Treasurer: Dr. Carlos V. Yambao, Philippine General Hospital, Manila.

Polish Ophthalmological Society

President: Dr. W. Kapuściński, Libelta 14, Poznań.
Secretary: Dr. S. Topolski, Piusa 38, Warsaw.
Place: Ophthalmic Clinic, Oczki 6, Warsaw. Time: Every two years—Summer.

Puerto Rico Medical Association, Section of Ophthalmology and Otolaryngology

President: Dr. José T. Picó, P. O. Box 3866, Santurce.
Secretary: Dr. Ricardo F. Fernández, Instituto Oftalmico, San Juan.
Place: Asociation Medica de Puerto Rico, Santuce.

Royal Society of Medicine, Section of Ophthalmology

President: Dr. Harold Levy, 149 Harley St., London, W. 1, England.
Secretaries: Dr. P. M. Moffatt, 115A Harley St., London, W. 1, England. Dr. A. S. Philps, 104 Hartley St., London W. 1, England.

São Paulo Society of Ophthalmology

President: Dr. Armando Gallo, Rua Benjamin Constant, 67, 9° Andar São Paulo, Brazil.
Secretary: Dr. F. Amédée Féret Filho, Rua Marconi, 48, 4° Andar, São Paulo. Brazil.

Scottish Ophthalmological Club

President: Dr. H. M. Traquair, 16 Manor Pl., Edinburgh 3.
Secretary: Dr. Alexander Garrow, 15 Woodside Pl., Glasgow, C. 3.
Place: Edinburgh and Glasgow, in rotation.

Sociedad Argentina de Oftalmologia

Chairman: Dr. Jorge Malbrán, Buenos Aires.
Secretary: Dr. Benito Just Tiscornia, Santa Fe 1171, Buenos Aires.

Sociedade Brasileira de Oftalmologia

President: Dr. Edilberto Campos, Rua Rodrigo Silva 7-1°, Rio de Janeiro, Brazil.
Secretary: Dr. Evaldo Campos, R. Rodrigo Silva 7-1° andar, Rio de Janeiro, Brazil.
Place: Rio de Janeiro, Brazil. Time: Third Friday of every month from April to December.

Sociedad Colombiana de Oftalmologia y de Otorrinolaringologia

President: Dr. Jorge Suárez-Hoyos, Carrera 5a, no. 13-39, Bogotá, Colombia.
Secretary: Dr. Fancisco Arango, Calle 20, no. 4-51, Bogotá, Colombia.
Place: Club Médico. Time: Second Tuesday of every month.
All correspondence should be addressed to the President.

Sociedad Chilena de Oftalmología

President: Prof. Dr. Halo Martini, Av Salvador, no. 300, Santiago, Chile.
Secretary: Dr. Adrian Araya, Av. Salvador, no. 300, Santiago, Chile.

SOCIEDAD CUBANA DE OFTALMOLOGIA

President: Prof. Lorenzo Comas, Calle D #461, Vedado, Habana, Cuba.
Secretary: Dr. Oscar F. Horstmann, Calle 5ta. #702, Vedado, Habana, Cuba.
Time: Second Tuesday of every month.

SOCIEDAD MEXICANA DE OFTALMOLOGIA

President: Dr. Feliciano Palomino Dena, Londres 44, Mexico, D. F.
Secretary: Dr. Teodulo Agundis Jr., Lucerna 63, Mexico, D. F.
Place: Escuela Nacional de Medicina, Venezuela 4, Mexico, D. F. Time: 8:30 p. m., first Tuesday of each month.

SOCIEDAD OFTALMOLOGIA DEL LITORAL, ROSARIO (ARGENTINA)

President: Prof. Dr. Enrique V. Bertolto, Rosario.
Secretary: Dr. Juan Manuel Vila Ortiz, Rosario.
Place: Rosario. Time: Last Saturday of every month, April to November. All correspondence should be addressed to the President.

SOCIEDADE DE OFTALMOLOGIA DE GUADALAJARA

President: Dr. Elias Mendoza González, Guadalajara, Mexico.
Secretary: Dr. L. Núñez Leal, Guadalajara, Mexico.

SOCIEDADE DE OFTALMOLOGÍA DEL NORTE

President: Dr. Alberto Cárdenas.
Secretary: Dr. Jorge Luis Castillo, Mendoza 421, Tucumán, Argentina.

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Secretary: Dr. Ennio Coscarelli, Rua Aimorés 1697, Bello Horizonte, Minas Geraes, Brazil.

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Secretary: Dr. Fernando Voges Alves, Caixa Postal 928, Porto Alegre, Rio Grande do Sul.

SOCIEDADE DE OFTALMOLOGIA E OTO-RHINO-LARYNGOLOGIA DO BAHIA

President: Dr. Theonilo Amorim, Barra Avenida, Bahia, Brazil.
Secretary: Dr. Adroaldo de Alencar, Brazil.
All correspondence should be addressed to the President.

SOCIETÀ OFTALMOLOGICA ITALIANA

President: Prof. Dott. Giuseppe Ovio, Ophthalmological Clinic, University of Rome, Rome.
Secretary: Prof. Dott. Epimaco Leonardi, Via del Gianicolo, 1, Rome.

SOCIÉTÉ FRANÇAISE D'OPHTALMOLOGIE

Secretary: Dr. René Onfray, 6 Avenue de la Motte Picquet, Paris, 7e.

SOCIETY OF SWEDISH OPHTHALMOLOGISTS

President: Prof. S. Larsson, Lund, Sweden.
Secretary: Dr. K. O. Granström, Södermalmstorg 4, Stockholm Sö.

SOUTHERN OPHTHALMOLOGICAL SOCIETY, ENGLAND

President: Mr. J. E. H. Cogan, Tunbridge Wells, England.
Secretary: Mr. Nigel Cridland, 25 Craneswater Pk., Southsea, England.
Time: From March to October.

TEL AVIV OPHTHALMOLOGICAL SOCIETY

President: Dr. D. Arieh-Friedman, 96 Allenby St., Tel Aviv, Palestine.
Secretary: Dr. Sadger Max, 9 Bialik St., Tel Aviv, Palestine.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Everett L. Goar, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Trygve Gundersen, 101 Bay State Rd., Boston.
Place: Chicago. Time: June 21-25, 1948.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, SECTION ON OPHTHALMOLOGY

President: Dr. C. H. McCaskey, 20 N. Meridian St., Indianapolis, Ind.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. Henry C. Haden, 1914 Travis St., Houston, Texas.
Secretary-Treasurer: Dr. Walter S. Atkinson, 129 Clinton St., Watertown, N. Y.

ASSOCIATION FOR RESEARCH IN OPHTHALMOLOGY, INC.

Chairman: Dr. Derrick Vail, 55 E. Washington St., Chicago 2.
Secretary-Treasurer: Dr. Brittain F. Payne, 17 E. 72d St., New York 2.
Assistant Secretary-Treasurer: Dr. Hunter Romain, 111 E. 65th St., New York.

CANADIAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

President: Dr. Alexander E. MacDonald, 170 St. George St., Toronto 5.

CANADIAN OPHTHALMOLOGICAL SOCIETY

President: Dr. R. J. P. McCulloch, 830 Medical Arts Bldg., Toronto 5.
Secretary-Treasurer: Dr. J. F. A. Johnston, 174 St. George St., Toronto 5.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. Mason H. Bigelow, 1790 Broadway, New York 19.
Secretary: Miss Regina E. Schneider, 1790 Broadway, New York 19.
Executive Director: Mrs. Eleanor Brown Merrill, 1790 Broadway, New York.

SECTIONAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. Anthony Ambrose, 31 Lincoln Park, Newark.
Secretary: Dr. W. Franklin Kein, 15 Washington St., Newark 2.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

CENTRAL ILLINOIS SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Clarence E. McClelland, Decatur, Ill.
Secretary-Treasurer: Dr. Philip R. McGrath, Peoria, Ill.

CENTRAL WISCONSIN SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. S. Jones, 521 Sheridan Rd., Menominee, Mich.
Secretary: Dr. G. L. McCormick, 650 S. Central Ave., Marshfield.

HAWAII EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. L. Q. Pang, 52 S. Vineyard, Honolulu.
Secretary-Treasurer: Dr. Harold F. Moffat, 1415 Kalakaua, Honolulu.
Place: Pacific Club, Honolulu. Time: Third Thursday of each month.

INTER-MOUNTAIN OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. James A. Cleary, 804 Boston Bldg., Salt Lake City.
Secretary-Treasurer: Dr. Homer E. Smith, 1105 Medical Arts Bldg., Salt Lake City.
Place: University Club, Salt Lake City. Time: 7:00 p. m., third Monday of each month, September through May.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. Edwin B. Dunphy, 243 Charles St., Boston.
Secretary-Treasurer: Dr. Merrill J. King, 264 Beacon St., Boston 16.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

PACIFIC COAST OTO-OPHTHALMOLOGICAL SOCIETY

President: Dr. D. H. O'Rourke, 1612 Tremont Pl., Denver.
Secretary-Treasurer: Dr. C. Allen Dickey, 450 Sutter St., San Francisco.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Robert Wightman, 1114 Boylston, Seattle, Wash.
Secretary-Treasurer: Dr. Barton E. Peden, 301 Stimson Bldg., Seattle 1, Wash.
Place: Seattle or Tacoma, Wash. Time: Second Tuesday of each month except June, July and August.

ROCK RIVER VALLEY EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Robert C. Finger, RFD New Tower, Rockford, Ill.
Secretary-Treasurer: Dr. Vernon C. Voltz, 625 Gas-Electric Bldg., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month from October to April, inclusive.

SAGINAW VALLEY ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Harold H. Heuser, 207 Davidson Bldg., Bay City, Mich.
Secretary-Treasurer: Dr. V. E. Cortopassi, 324 S. Washington Ave., Saginaw, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July, August and September.

SIOUX VALLEY EYE AND EAR ACADEMY

President: Dr. J. C. Decker, 515 Francis Bldg., Sioux City, Iowa.
Secretary-Treasurer: Dr. J. E. Dvorak, 408 Davidson Bldg., Sioux City, Iowa.

SOUTHERN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Calhoun McDougall, Atlanta, Ga.
Secretary: Dr. Alston Callahan, 908 S. 20th St., Birmingham 5, Ala.
Time: First week in November.

SOUTHWESTERN ACADEMY OF EYE, EAR, NOSE AND THROAT

President: Dr. H. L. Brehmer, 221 W. Central Ave., Albuquerque, N. Mex.
Secretary: Dr. A. E. Cruthirds, 1011 Professional Bldg., Phoenix, Ariz.

SOUTHWESTERN MICHIGAN TRIOLOGICAL SOCIETY

President: Dr. W. M. Dodge, 716 First National Bank Bldg., Battle Creek.
Secretary-Treasurer: D. Kenneth Lowe, 25 W. Michigan Ave., Battle Creek.
Time: Last Thursday of September, October, November, March, April and May.

WESTERN PENNSYLVANIA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. J. Paul McCloskey, 338 Locust St., Johnstown.
Secretary-Treasurer: Dr. Fred E. Murdock, 28½ W. Scribner St., Dubois.

STATE

ARKANSAS STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. E. C. Moulton, 619 Garrison Ave., Fort Smith.
Secretary: Dr. K. W. Cosgrove, 7 Urquhart Bldg., Little Rock.

COLORADO OPHTHALMOLOGICAL SOCIETY

President: Dr. George H. Stine, Burns Bldg., Colorado Springs.
Secretary: Dr. J. Leonard Swigert, 320 Republic Bldg., Denver.
Place: Colorado General Hospital. Time: 7:30 p. m., third Saturday of each month, October to May, inclusive.

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. W. H. Turnley, 1 Atlantic St., Stamford, Conn.
Secretary-Treasurer: Dr. Morton B. Arnold, 781 Main St., Williamantic, Conn.

EYE, EAR, NOSE AND THROAT CLUB OF GEORGIA

President: Dr. William O. Martin Jr., Doctors Bldg., Atlanta.
Secretary-Treasurer: Dr. C. K. McLaughlin, 666 Cherry St., Macon.

INDIANA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. W. E. Stewart, 721 Wabash Ave., Terre Haute.
Secretary: Dr. Russell A. Sage, 23 E. Ohio St., Indianapolis.

IOWA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. C. S. O'Brien, University Hospital, Iowa City.
Secretary-Treasurer: Dr. Carl A. Noe, 120–3d Ave. S. E., Cedar Rapids.

KANSAS STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. B. Granger, Emporia.
Secretary: Dr. George F. Gsell, 911 Beacon Bldg., Wichita 2.

LOUISIANA-MISSISSIPPI OPHTHALMOLOGICAL AND OTOLARYNGOLOGICAL SOCIETY

President: Dr. George S. Adkins, 121 N. President St., Jackson, Miss.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.

MEDICAL SOCIETY OF THE STATE OF PENNSYLVANIA, SECTION ON EYE, EAR, NOSE AND THROAT DISEASES

Chairman: Dr. William T. Hunt Jr., 1205 Spruce St., Philadelphia 7.
Secretary: Dr. Gabriel Tucker, 250 S. 18th St., Philadelphia 3.

MICHIGAN STATE MEDICAL SOCIETY, SECTION OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

Chairman: Dr. Ralph H. Gilbert, 110 Fulton St. E., Grand Rapids.
Secretary: Dr. Walter Z. Rundles, 620 Maxine Ave., Grand Rapids.

MINNESOTA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. R. Boies, 1427 Medical Arts Bldg., Minneapolis.
Secretary: Dr. W. L. Hoffman, 543 Medical Arts Bldg., Minneapolis.
Place: Minneapolis Club. Time: 6:00 p. m., second Friday of each month from October to May.

MONTANA ACADEMY OF OTO-OPHTHALMOLOGY

President: Dr. H. Casebeer, 44 W. Park Ave., Butte.
Secretary: Dr. Fritz D. Hurd, 309 Medical Arts Bldg., Great Falls.

NEBRASKA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. John Peterson, 1307 N St., Lincoln.

NEW JERSEY STATE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY, OTOLOGY AND RHINOLARYNGOLOGY

Chairman: Dr. C. W. Buvinger, 50 Washington St., East Orange.
Secretary: Dr. Z. Laurence Griesemer, 1145 E. Jersey St., Elizabeth.

NEW YORK STATE MEDICAL SOCIETY, EYE, EAR, NOSE AND THROAT SECTION

Chairman: Dr. Maxwell D. Ryan, 660 Madison Ave., New York 21.
Secretary: Dr. Thomas H. Johnson, 30 W. 59th St., New York.

NORTH CAROLINA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. V. K. Hart, 106 W. 7th St., Charlotte.
Secretary: Dr. J. A. Harrill, Bowman Gray School of Medicine, Winston-Salem.

NORTH DAKOTA ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. E. D. Perrin, 221–5th St., Bismarck.
Secretary-Treasurer: Dr. M. T. Lampert, Minot.

OREGON ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Wilfred Belnap, 833 S. W. 11th Ave., Portland.
Secretary-Treasurer: Dr. C. W. Kuhn, 1020 S. W. Taylor St., Portland 5.
Place: Good Samaritan Hospital, Portland. Time: Third Tuesday of each month.

PENNSYLVANIA ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Gilbert L. Dailey, Harrisburg.
Secretary: Dr. Benjamin F. Souders, 143 N. 6th St., Reading.
Place: Hotel Penn-Harris, Harrisburg, Pa. Time: April 23-25, 1948.

RHODE ISLAND OPHTHALMOLOGICAL AND OTOLOGICAL SOCIETY

Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Society, Library, Providence. Time: 8:30 p. m., second Thursday in October, December, February and April.

SOUTH CAROLINA SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. Richard W. Hanckel, 96A Bull St., Charleston.
Secretary-Treasurer: Dr. Roderick Macdonald, 330 E. Main St., Rock Hill.

TENNESSEE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. George Burchfield, Maryville.
Secretary-Treasurer: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis.

TEXAS OPHTHALMOLOGICAL AND OTO-LARYNGOLOGICAL SOCIETY

President: Dr. W. E. Vandevere, 1001 First National Bank Bldg., El Paso.
Secretary: Dr. E. D. Dumas, 425 Medical Arts Bldg., San Antonio.

VIRGINIA SOCIETY OF OTO-LARYNGOLOGY AND OPHTHALMOLOGY

President: Dr. Thomas E. Hughes, 1000 W. Grace St., Richmond.
Secretary-Treasurer: Dr. Francis H. McGovern, 105 S. Union St., Danville.

WEST VIRGINIA STATE MEDICAL ASSOCIATION, EYE, EAR, NOSE AND THROAT SECTION

President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

AKRON ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. R. F. Thaw, 301 Ohio Bldg., Akron, Ohio.
Secretary-Treasurer: Dr. J. C. Damitz, 2d National Bank Bldg., Akron 8, Ohio.
Time: 6:30 p. m., first Monday in January, March, May and November.

ATLANTA EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. William B. Armstrong, 478 Peachtree St. N. E., Atlanta, Ga.
Secretary: Dr. Lester A. Brown, 815 Doctors Bldg., Atlanta, Ga.
Place: Academy of Medicine. Time: 7:00 p. m., fourth Monday of each month from October to May.

BALTIMORE MEDICAL SOCIETY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Cecil H. Bagley, 2 E. Reed St., Baltimore.
Secretary: Dr. F. Edwin Knowles Jr., 513 N. Charles St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to March.

BIRMINGHAM EYE, EAR, NOSE AND THROAT CLUB

President: Each member, in alphabetical order.
Secretary: Dr. W. Chunn Parsons, 425 Woodward Bldg., Birmingham, Ala.
Place: Thomas Jefferson Hotel. Time: 6:30 p. m., second Tuesday of each month, September to May, inclusive.

BROOKLYN OPHTHALMOLOGICAL SOCIETY

President: Dr. Benjamin C. Rosenthal, 140 New York Ave., Brooklyn 16.
Secretary-Treasurer: Dr. Louis Freimark, 256 Rochester Ave., Brooklyn 13.
Place: Towers Hotel, 25 Clark St. Time: 8:15 p. m., third Thursday in February, April, October and December.

BUFFALO OPHTHALMOLOGIC CLUB

President: Dr. William H. Howard, 389 Linwood Ave., Buffalo 9.
Secretary-Treasurer: Dr. Sheldon B. Freeman, 196 Linwood Ave., Buffalo 9.
Time: Second Thursday of each month from October to May.

CENTRAL NEW YORK EYE, EAR, NOSE AND THROAT SOCIETY

President: Dr. Uri Doolittle, University Bldg., Syracuse.
Secretary-Treasurer: Dr. Alfred W. Doust, 306 State Tower Bldg., Syracuse.
Place: University Club. Time: 7:00 p. m., second Wednesday.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. Douglas Chamberlain, Providence Bldg., Chattanooga, Tenn.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Beulah Cushman, 25 E. Washington St., Chicago 2.
Secretary: Dr. J. R. Fitzgerald, 30 N. Michigan Ave., Chicago 2.
Place: Continental Hotel, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati General Hospital Ophthalmology Staff

Chairman: Rotate alphabetically.
Secretary: Dr. A. A. Levin, 441 Vine St., Cincinnati.
Place: Cincinnati General Hospital. Time: 7:45 p. m., third Friday of each month except June, July and August.

Cleveland Ophthalmological Club

Chairman: Dr. John E. L. Keyes, 22199 McCauley Rd., Shaker Heights 22, Ohio.
Secretary: Dr. Roscoe J. Kennedy, 2020 E. 93d St., Cleveland 6.
Time: Second Tuesday in October, December, February and April.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Perce de Long, 37 S. 20th St., Philadelphia.
Clerk: Dr. M. Luther Kauffman, Medical Arts Bldg., Jenkintown, Pa.
Place: College of Physicians Bldg. Time: 8:15 p. m., third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. M. Goldberg, 328 E. State St., Columbus, Ohio.
Secretary-Treasurer: Dr. W. J. Miller, 21 E. State St., Columbus, Ohio.
Place: University Club. Time: 6:15 p. m., first Monday of each month, from October to May, inclusive.

Corpus Christi Eye, Ear, Nose and Throat Society

Chairman: Dr. Edgar Mathis, 815 Medical Professional Bldg., Corpus Christi, Texas.
Secretary: Dr. June Yates, 210 Medical Professional Bldg., Corpus Christi, Texas.
Place: Nueces Hotel. Time: 6:30 p. m., third Tuesday of each month from October to May.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. Darrough, 4105 Live Oak St., Dallas, Texas.
Secretary: Dr. C. A. Hoefer, 1719 Pacific Ave., Dallas 1, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. H. I. McPherrin, 406–6th Ave., Des Moines, Iowa.
Secretary-Treasurer: Dr. C. C. Jones, 1110 Equitable Bldg., Des Moines, Iowa.
Time: 6:30 p. m., fourth Monday of every month from September to May.

Detroit Ophthalmological Club

Chairman: Members rotate alphabetically.
Secretary: Dr. Wesley G. Reid, 974 Fisher Bldg., Detroit 2.
Place: Club rooms of Wayne County Medical Society. Time: Second Monday of each month, November to April, inclusive.

Detroit Ophthalmological Society

President: Dr. Bruce Fralick, 201 S. Main St., Ann Arbor, Mich.
Secretary: Dr. William S. Gonne, 619 David Whitney Bldg., Detroit 26.
Place: Hayler's L'Aiglon Bldg. Time: 6:30 p. m., third Thursday of each month from November to April, inclusive.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. Frank C. Furlong, 713 Union St., Schenectady.
Secretary-Treasurer: Dr. E. Martin Freund, 762 Madison Ave., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. C. R. Lees, 602 W. 10th St., Fort Worth 2, Texas.
Secretary-Treasurer: Dr. Van D. Rathgeber, 1305 Medical Arts Bldg., Fort Worth, Texas.
Place: Tarrant County Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Ophthalmological and Oto-Laryngological Section

President: Dr. J. Matt Robison, 1304 Walker Ave., Houston, Texas.
Secretary: Dr. John H. Barrett, 1304 Walker Ave., Houston, Texas.
Place: River Oaks Country Club. Time: 6:30 p. m., second Thursday of each month from October to June.

Indianapolis Ophthalmological and Otolaryngological Society

President: Dr. D. Hamilton Row, 23 E. Ohio St., Indianapolis.
Secretary: Dr. J. Lawrence Sims, 23 E. Ohio St., Indianapolis.
Place: Indianapolis Athletic Club. Time: 6:30 p. m., second Thursday of each month from November to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. Walter L. Small, 1103 Grand Ave., Kansas City, Mo.
Secretary: Dr. John Clair Howard Jr., 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Robert G. Thornburgh, 117 E. 8th St., Long Beach 2, Calif.
Secretary-Treasurer: Dr. Kirt Parks, 605 Professional Bldg., Long Beach 2, Calif.
Place: Seaside Hospital. Time: Third Wednesday of each month from October to May.

Los Angeles Ophthalmological Society

Chairman: Dr. Orwyn Ellis, 727 W. 7th St., Los Angeles 14.
Secretary: Dr. John A. Bullis, 3875 Wilshire Blvd., Los Angeles 5.
Place: 3550 Wilshire Blvd., Los Angeles. Time: 6:30 p. m., third Tuesday of each month, September through June.

Los Angeles Society of Ophthalmology and Otolaryngology

President: Dr. William D. Donoher, Los Angeles.
Secretary-Treasurer: Dr. K. C. Brandenburg, 110 Pine Ave., Long Beach 2, Calif.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:00 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye and Ear Society

President: Dr. Joseph S. Heitger, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. W. Fish, 321 W. Broadway, Louisville, Ky.
Place: Brown Hotel. Time: 6:30 p. m., second Thursday of each month from September to May, inclusive.

Lower Anthracite Eye, Ear, Nose and Throat Society

Chairman: Each member in alphabetical order.
Secretary: Dr. James J. Monohan, 31 S. Jardin St., Shenandoah, Pa.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. P. S. Constantinople, 1835 I St. N. W., Washington.
Secretary: Dr. Frazier Williams, 1801 I St. N. W., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month from September to May.

Milwaukee Oto-Ophthalmic Society

President: Dr. Meyer S. Fox, 238 W. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Ralph T. Rank, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., fourth Tuesday of each month from October to May.

Montgomery County Medical Society

Chairman: Dr. H. V. Dutrow, 1040 Fidelity Medical Bldg., Dayton, Ohio.
Secretary-Treasurer: Dr. Maitland D. Place, 981 Reibold Bldg., Dayton, Ohio.
Place: Van Cleve Hotel: Time: 6:30 p. m., first Tuesday of each month from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. L. F. Badeaux, 502 Cherrier St., Montreal, Canada.
Secretary: Dr. John V. V. Nicholls, 1414 Drummond St., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. M. M. Cullom, 700 Church St., Nashville, Tenn.
Secretary: Dr. R. E. Sullivan, 432 Doctors Bldg., Nashville 3, Tenn.
Place: James Robertson Hotel. Time: 6:30 p. m., third Monday of each month from October to May.

New Orleans Ophthalmological and Otolaryngological Society

President: Dr. Charles A. Bahn, Maison Blanche Bldg., New Orleans.
Secretary: Dr. Mercer G. Lynch, Ochsner Clinic, New Orleans.
Place: Charity Hospital. Time: 8 p. m., first Tuesday of every month.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Guernsey Frey, New York.
Secretary: Dr. Maynard Wheeler, 30 W. 59th St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

New York Society for Clinical Ophthalmology

President: Dr. Daniel Kravitz, 861 Park Pl., Brooklyn.
Secretary: Dr. Leon Ehrlich, 211 Central Park W., New York.
Place: New York Academy of Medicine, 2 E. 103d St. Time: 8 p. m., first Monday of each month from October to May, inclusive.

Oklahoma City Academy of Ophthalmology and Otolaryngology

President: Dr. S. R. Shaver, 117 N. Broadway, Oklahoma City.
Secretary: Dr. William Mussil, Medical Arts Bldg., Oklahoma City.
Place: University Hospital. Time: Second Tuesday of each month from September to May.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. Lyman H. Heine, Fremont, Neb.
Secretary-Treasurer: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha 2.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m. dinner; 7 p. m. program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. Thomas Sanfacon, 340 Park Ave., Paterson, N. J.
Secretary-Treasurer: Dr. J. Averbach, 435 Clifton Ave., Clifton, N. J.
Place: Doctors Lounge, Paulsen Medical and Dental Bldg. Time: 8 p. m., last Tuesday of each month except June, July and August.

Philadelphia County Medical Society, Eye Section

President: Dr. L. Waller Deichler, 1930 Chestnut St., Philadelphia 3.
Secretary: Dr. Robert T. M. Donnelly, 255 S. 17th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. Charles L. Reed, Jenkins Arcade, Pittsburgh.
Secretary: Dr. Samuel D. Evans, Park Bldg., Pittsburgh 22.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Reading Eye, Ear, Nose and Throat Society

President: Dr. Arthur A. Bobb, 346 N. 5th St., Reading, Pa.
Secretary: Dr. Paul C. Craig, 232 N. 5th St., Reading, Pa.
Place: Wyomissing Club. Time: 6:30 p. m., third Wednesday of each month from September to July.

Richmond Eye, Ear, Nose and Throat Society

President: Dr. Edgar Childrey Jr., Professional Bldg., Richmond, Va.
Secretary: Dr. Clifford A. Folkes, Professional Bldg., Richmond, Va.
Place: Commonwealth Club. Time: 6 p. m., first Tuesday of January, March, May and October.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Charles T. Sullivan, 277 Alexander St., Rochester, N. Y.

St. Louis Ophthalmic Society

President: Dr. A. Lange, 3903 Olive St., St. Louis.
Secretary: Dr. William Kleinberg, Frisco Bldg., St. Louis.
Place: McMillan Hospital. Time: Fourth Friday of each month from October to April, inclusive, except December, at 8:00 p. m.

San Antonio Society of Ophthalmology and Otolaryngology

President: Dr. John L. Matthews, Nix Professional Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. A. F. Clark Jr., Medical Arts Bldg., San Antonio, Texas.
Place: San Antonio, Texas, Brooke General Hospital and Randolph Field. Time: 7 p. m., second Tuesday of each month from September to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. J. W. Bettman, 2400 Clay St., San Francisco 15.
Secretary: Dr. William Duggan, 490 Post St., San Francisco 2.
Place: Society's Bldg., 2180 Washington St., San Francisco 9. Time: Fourth Tuesday of every month except June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. David C. Swearingen, Slattery Bldg., Shreveport, La.
Secretary-Treasurer: Dr. Kenneth Jones, Medical Arts Bldg., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Robert L. Pohl, 762 Paulsen Medical and Dental Bldg., Spokane, Wash.
Secretary: Dr. Malcolm N. Wilmes, 960 Paulsen Medical and Dental Bldg., Spokane, Wash.
Place: Doctors Lounge, Paulsen Medical and Dental Bldg. Time: 8 p. m., last Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. A. H. Rubenstein, 713 E. Genesee St., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. H. Blaisdell, 713 E. Genesee St., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toledo Eye, Ear, Nose and Throat Society

Chairman: Dr. W. W. Randolph, 1838 Parkwood Ave., Toledo 2, Ohio.
Secretary: Dr. John L. Roberts, 316 Michigan St., Toledo, Ohio.
Place: Toledo Club. Time: 6:30 p. m., each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. R. G. C. Kelly, 14 Lynwood Ave., Toronto 5, Canada.
Secretary: Dr. J. C. McCulloch, 830 Medical Arts Bldg., Toronto 5, Canada.
Place: Academy of Medicine, 288 Bloor St. W. Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. Richard W. Wilkinson, 1408 L St. N. W., Washington, D. C.
Secretary-Treasurer: Dr. Jerome A. Sansoucy, 2017 Massachusetts Ave. N. W., Washington, D. C.
Place: Medical Society of District of Columbia Bldg., 1718 M St. N. W., Washington, D. C. Time: 7:30 p. m., first Monday of each month from November to May.

Wilkes-Barre Ophthalmological Society

Chairman: Each member in turn.
Secretary: Dr. Samuel T. Buckman, 70 S. Franklin St., Wilkes-Barre, Pa.
Place: County Medical Society Library. Time: Last Tuesday of each month from October to May.